MODERN PLASTICS

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Next Month

"This Plastic Age of Color" an article written exclusively for us by Howard Ketchem, color engineer and consultant, explains the true purpose of color in commerce and points to the advantages that belong to the alert merchandiser who adjusts his marketing program to established color preferences and trends. We shall also inaugurate in the June issue a new feature, PLASTICS DIGEST, in which we shall endeavor to present brief abstracts of all articles that discuss the subject of plastics, wherever published. There will be a story on Moulage, a scientifically developed molding material used at the Federal Bureau of Investigation in Washington, for making death masks and other perpetual records of crimes and their evidence

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MODERN PLASTICS

MAY 1937 VOLUME 14 NUMBER 9

DUREZ

by
JEAN MAYER

WHERE BEAUTY BEGINS

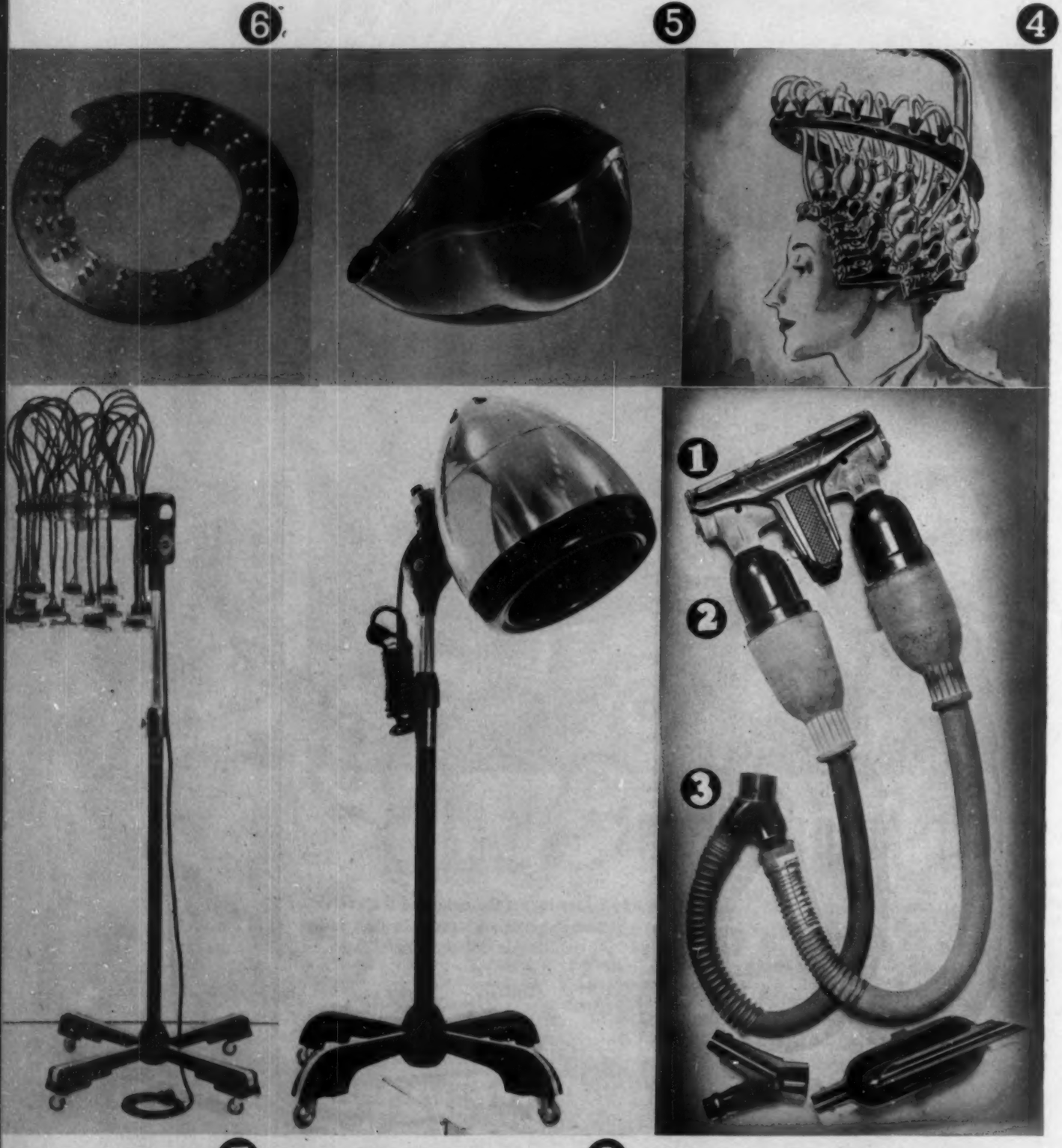
Smart beauty salons reflect the nature of their service through efficient equipment and simple design

BEAUTY SHOP EQUIPMENT, DURING THE PAST year, has reached the status of a major industry, according to a booklet issued by the U. S. Department of Commerce which classifies all industry for the Census of Manufactures. The reason for this distinction, and for the facts and figures surrounding it, can probably be traced to the successful and intense promotion by manufacturers of cosmetics who have put forth a concertive effort to bring the hair-dressing parlor up-to-date.

The modern beauty shop has long since taken over the duties of the hair-dressing parlor, ousted its antiquated methods and set up efficient and business-like equipment in its place. Trained operators, many of whom have made exhaustive studies in dermatology, and scalp conditions, have supplanted the old time hairdresser who made her exit upon the entrance of the permanent wave.

This educational work by manufacturers of beauty preparations through advertising and propaganda has

1, 2, 3, 4. Parts of a steam waving machine molded for the Duart Mfg. Company showing molded connectors, steam traps and clips. 5. Hairdryer hood molded by The Gorham Company for the Halliwell Division of the American Machine and Metals, Inc. Hood weighs 4 lbs. and was molded in a 450 ton press from beryllium copper mold. 6, 7. Ring for a permanent wave machine molded by the Auburn Button Wks. Inc. for W. G. Shelton Company. 8. Rim for hairdryer molded by the Consolidated Molded Products Corp. for W. G. Shelton Company



established these thousands of individual shops into a substantial and rapidly growing industry. They have attracted the attention of well-groomed women and pointed out to them the advantages of the services and preparations they have to sell.

The growth of this business has been rapidly accentuated by the development of ingenious and scientific methods and equipment for the various treatments, especially that of permanent waving and care of the hair and scalp. It is in this development particularly that plastics have contributed to the safety and efficiency of the apparatuses as well as to their physical appearance and sanitary characteristics.

One of the major requirements of all beauty shop equipment is safety. Both heat and electricity are used in quantities that could easily be dangerous to the operator and customer alike unless properly controlled.

Another major requirement is that of cleanliness and sanitation. Smooth surfaces that can be easily cleaned and retain their finish are quite essential, and materials used in such equipment must resist steam, hot water and the ingredients used in all beauty preparations.

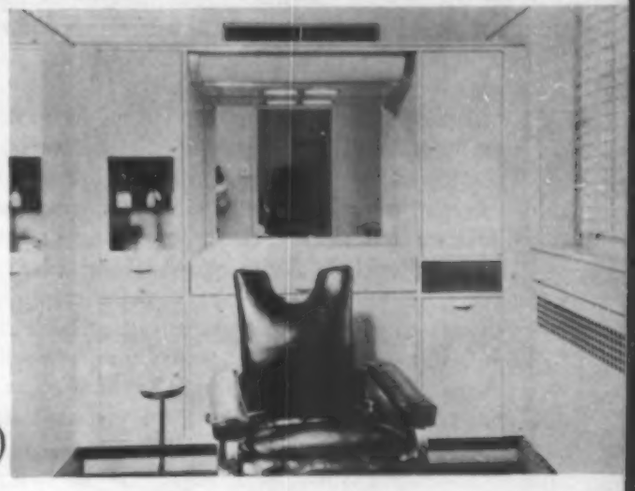
The third, which is no less important than the other two, is a modern and inviting appearance to the shop and its furnishings. This is especially true in beauty shops located in department or specialty shops where their proximity to the incidental and natural traffic lanes must attract and invite.

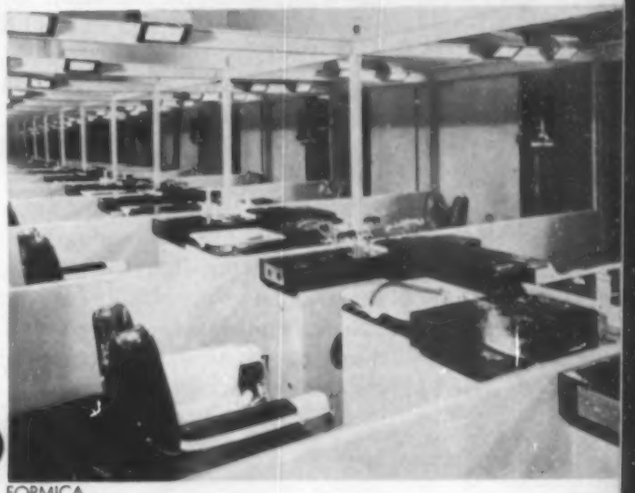
In all three of these major requirements, plastics combine with other materials to bring the desired results.

For example, the permanent wave machine we have illustrated (Fig. 7) is equipped with a plastic ring which supports the heaters and also serves to give them their electrical connection, supplying heat when they are clamped to strands of curled hair to be waved. The advantages of plastics in this instance are obvious and you will note in Fig. 6 that the inserts which form the electrical connection are molded into the ring reducing assembly costs and precluding any possibility of short circuiting. The fact that this ring is made of molded plastic material obviates any necessity for further insulating because the material is molded insulation itself. Being plastic it neither holds nor transmits heat and cannot under any circumstances become a source of danger either to the operator or the client.

There are fifty-four metal inserts which serve as connectors for the cords and these are placed in the mold in advance of the molding operation and become an integral part of the device. While eliminating assembly operations influences the original cost the fact that these connectors cannot become loosened in service lessons the operating cost and prevents incidental delays which would be caused by repairs.

Another machine in current use for permanent hair waving takes its heat from steam rather than electricity but requires a feeder ring not unlike that on the electrical machine, and very much the same requirements are demanded from this ring in use. It serves as an attaching device for the flexible tubes which conduct the heat to the clips in which the hair is wound. The material from which it is made is in constant contact with moisture and must therefore be made of non-corrosive material and one which will not absorb the heat but will allow it to pass through the tube to the clips where its service is required. A plastic material (*Continued on page 68*)





FORMICA

9. Booths and table tops are veneered with inlaid laminated in the beauty shop at Block's Department Store, Indianapolis. 10. Laminated wainscoting, Jacqueline Cochrane shop, Chicago in which all booth interiors are of laminated designed by Holabird & Root. 11. Laminated tops with center sliding unit, Elizabeth Arden Beauty Salon, Chicago

SELECTING SPECIAL PHENOLIC MATERIALS

by FRANKLIN E. BRILL
General Plastics, Inc.

THE AVERAGE BUYER OF PHENOLIC MOLDINGS finds that every fourth order he places requires the use of a special molding material having properties not found in standard compounds. Your next molded part may fall into this category, and the better your understanding of different types of phenolic materials, the greater are your chances of satisfaction.

Among the conditions encountered by molded parts are heat, acids, perspiration, frictional wear, impact, alkalies, electrical arcing, machining operations, steam, solvents, water, oils, and special problems arising from intricate construction, placement of inserts and mechanical peculiarities. A few years ago, standard molding materials withstood some of these conditions well enough to get by, but frequently they made the use of molded parts impractical. Since then, phenolic plastic manufacturers have developed a number of special-property materials to fit these difficult applications, and have broadened the usefulness of plastics considerably.

Take for example, a sprinkler system switch of the dry-pipe type, which is maintained under air pressure but becomes drenched by water when a head blows and the system goes into action. A mercury globule makes the contact in the electric switch when the air pressure drops, so the material must be resistant to water, mercury and electrical current, which eliminates metal immediately. The answer proves to be a special water-, acid-, and alkali-resistant phenolic material, of which the entire switch mechanism and housing are molded, as shown in the accompanying illustration. (Fig. 5.)

Or let us suppose that you're planning a new telephone handset and base, requiring extra impact strength to withstand rough usage, and also resistance to frictional wear and perspiration, which sometimes exert a damaging effect on the surface of ordinary moldings and eventually result in slight pits and exposure of filler material. To cope with these conditions, a material has been developed with the property of resisting frictional wear and moisture without exposure of filler particles. And because of the frequent need of machining operations on parts of this type, this material also permits sanding, machining or grooving and subsequent buffing to bring back the molding to its original luster—without impairing its resistance to frictional wear and perspiration.

1

Water valve parts

Or, suppose you're a manufacturer of toilet flush valves and that your metal piston unit has been a source of annoyance through wear against other metal parts with subsequent chattering during flushing. From the list of special phenolic materials you choose one that is resistant to water and alkalies, which will not swell or crack with sudden changes of temperature and which has the property of wearing better than metal when in contact with other metal parts. You will find that this reduction in wear eliminates the troublesome chattering, and that the molding resists corrosion and gives a more silent, more positive action in the valve. Such a piston assembly is shown here. (Fig. 2.)

Such a list could continue indefinitely, perhaps without coming close to the problem of using plastics in your product. To show the diversity of today's special materials, a chart of some of the more common problems, the uses of the molded parts, properties required and the material recommended, is shown on page 67.

Not included in the chart but nonetheless important are problems arising from the construction of the molding. For instance, molding a large, flat, short-draw piece and eliminating cooling-warpage on removal from the mold, requires a material with a rigid setup which will resist distortion even on hot-ejection. Such a material has been developed for refrigerator crisper trays, scale plates, instrument or machine housings which must hold accurate tolerances, chair arms, large serving trays and many other flat parts.

In contrast to this rigid setup is a special material developed to give the opposite effect—a flexible setup in the mold to eliminate cracking around difficult inserts or connected inserts subject to temperature variation. In other words, a metal part imbedded in a molding may be of such length that the difference in the coefficients of expansion of metal and molding material sets up strains upon removal from the hot mold. This material's flexibility eliminates cracks during shrinking, by adjusting the molding to the shrinkage of the insert.

(Continued on page 67)

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1. Trays like these must set up rigidly in the mold or shrinkage strains on cooling will warp them. They are ejected into room temperature from molds heated to 250 deg. F. or over

2. Tests equaling five years' service were given this Speakman's toilet flush valve to prove that its molded phenolic piston wore less than metal, didn't swell. A moisture- and wear-resistant material is used, chattering eliminated

3. Sampson-United's Tri-Matic molded base employs impact-resistant compound to resist shocks and bumps. Smoothness and luster are normal

4. Leich Electric Company chooses a phenolic material which doesn't show filler spots from constant handling and perspiration. Parts may be machined and buffed to normal luster

5. For dry-pipe sprinkler systems, Globe Automatic Sprinkler Co. makes this mercury switch of a special moisture- and acid-resistant compound to withstand the effect of water and mercury

PLASTIC MODES

by EVE MAIN

With subtle persistence, plastics in one form or another have invaded the fashion field and have practically taken it over without a struggle. A substantial percentage of today's costume jewelry and trim, as well as high fashion fabrics, are products of modern chemistry and their kinship to industrial and decorative plastics is so little removed that we picture them here to show the extent of the applications of these versatile materials. 1. This black hat with its generous white trim in "flower basket" style, is made entirely of slit cellulose film. 2. Water repellents with cellulose base, make practical and serviceable a knee length silver colored satin rain cape. The transparent bracelet type umbrella handle is also of plastic material. 3. Chemical water repellents do not alter the feel or texture of fabrics in any way and can be applied to such delicate materials as silk, satin or velvet. This ivory satin evening gown and flame-red velvet cape have both been treated with a special waterproofing process making them virtually immune to stains and moisture. 4, 5. Every thread in the full skirted white taffeta gown and black hooded cape, as well as in the skin tone lace evening gown and wrap was spun from the acetate kettle. Satin evening sandals worn with these gowns, although invisible in the pictures, are worthy of mention because the soles are attached with a new cellulose cement doing away with nails and stitching, contributing to comfort and flexibility. 6, 7, 8. Contrasting slide fasteners, buckles and such on these daytime dresses and bags are all of cellulose acetate material as are the "scuffless" heels on the shoes. Hats which complete the ensembles are nearly all of slit cellulose film, with plastic trim. (Apparel photographs courtesy du Pont)

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A breath of spring, a hint of summer, and these new "Oxide" daisy buttons blossom becomingly and permanently on warm weather jackets and frocks. True to nature they appear in two-color splendor—yellow with brown centers, white with yellow centers and others which depart somewhat from nature's colors but are effective nevertheless. (Synthetic Moulded Products, Inc.)

INJECTION MOLDING, HERE AND ABROAD

by J. F. GEERS
Index Machinery Corporation

Recently returned from a visit to Europe, the author reviews some of his impressions for the benefit of those interested in injection molding

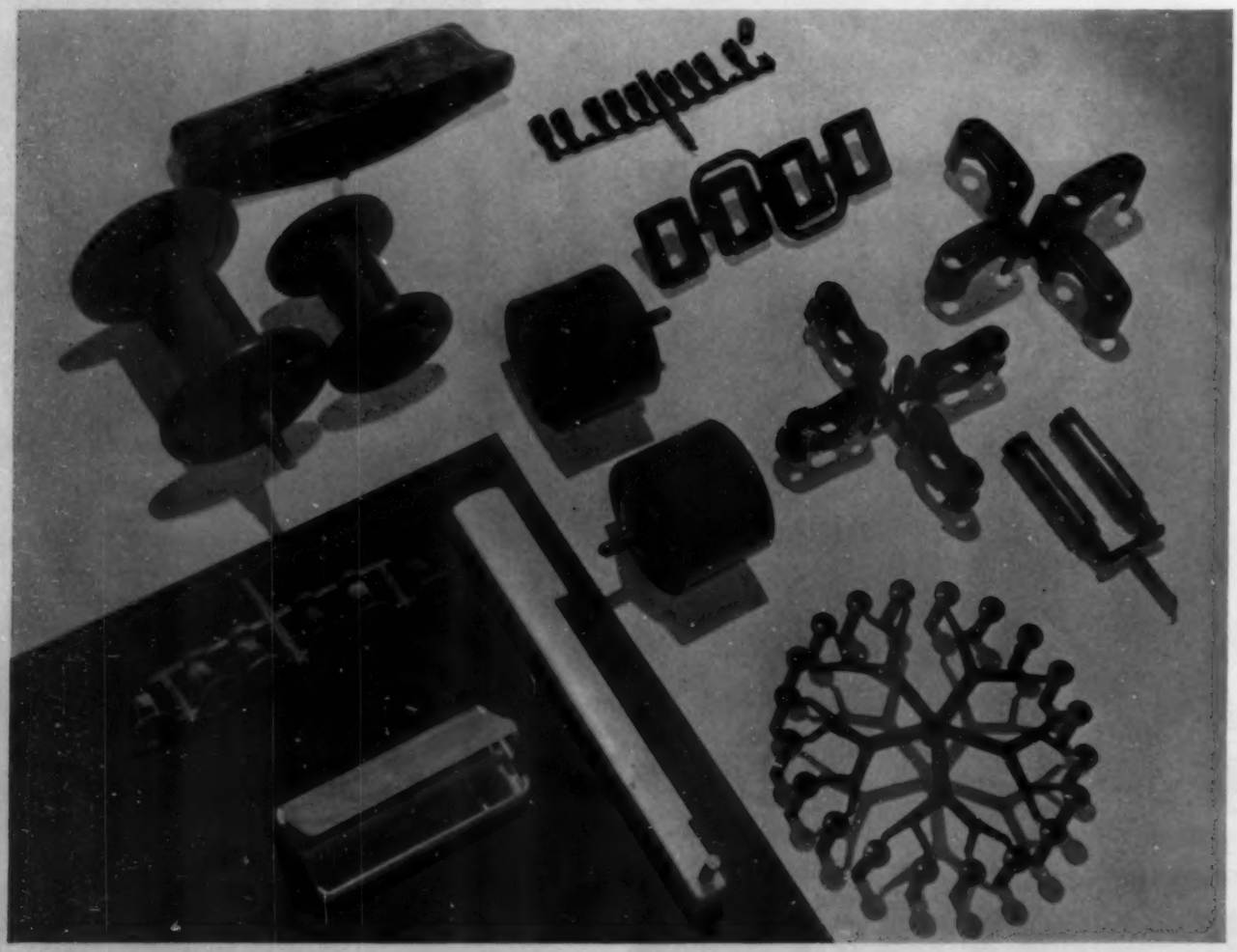
FROM MY PREVIOUS VISITS TO EUROPE IN THE interest of acquainting our factory with the needs of American molders as we have found them during the several years in which we have been intimately associated with the industry, I was well aware of the conditions and practices which existed there. One of the outstanding differences in the application of injection molding between the United States and abroad is the more general tendency in this country to employ injection molding for component parts of industrial and decorative equipment. Whereas, in Europe, the tendency is toward the development of novelties, inexpensive jewelry, badges of various kinds, artistic closures, small toys, cosmetic containers, and similar items.

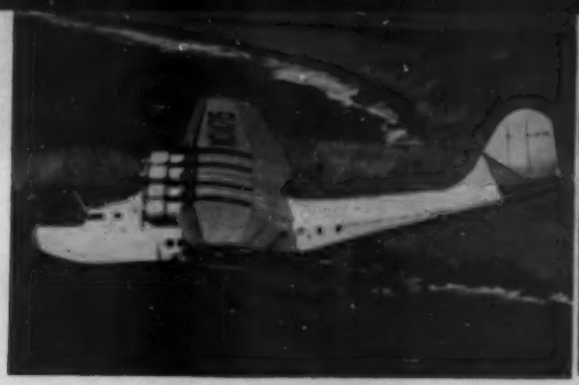
France, as an example, is recognized the world over for its cosmetic products. American women are firmly convinced that no others are as good. And it should be added that France is probably maintaining the lead in the application of injection molded containers for these cosmetic and similar products.

Hardware covering also offers a large field for this type of molding, not alone for decoration, but for adding life and service to the finish of the product. Australia has probably contributed more than its normal share toward the development of this sort of molding and through the efforts of Australian molders has proven that a profitable field lies ahead in this line of endeavor. There is no doubt that within a very short space of time American car manufacturers will adopt the use of colored handles to match the exterior finish of their cars and when this is done, plastics will provide this color.

English molders are contrib- (*Continued on page 72*)

European examples of injection molding showing "gates" still attached to several parts





PAN-AMERICAN AIRWAYS

PIERCE ARROW TRAVELODGE, PINCHES TRAILER CORP.

BEETLE

FLYING DISHES

The above photograph shows molded tableware arranged for dinner aboard a Yankee Clipper

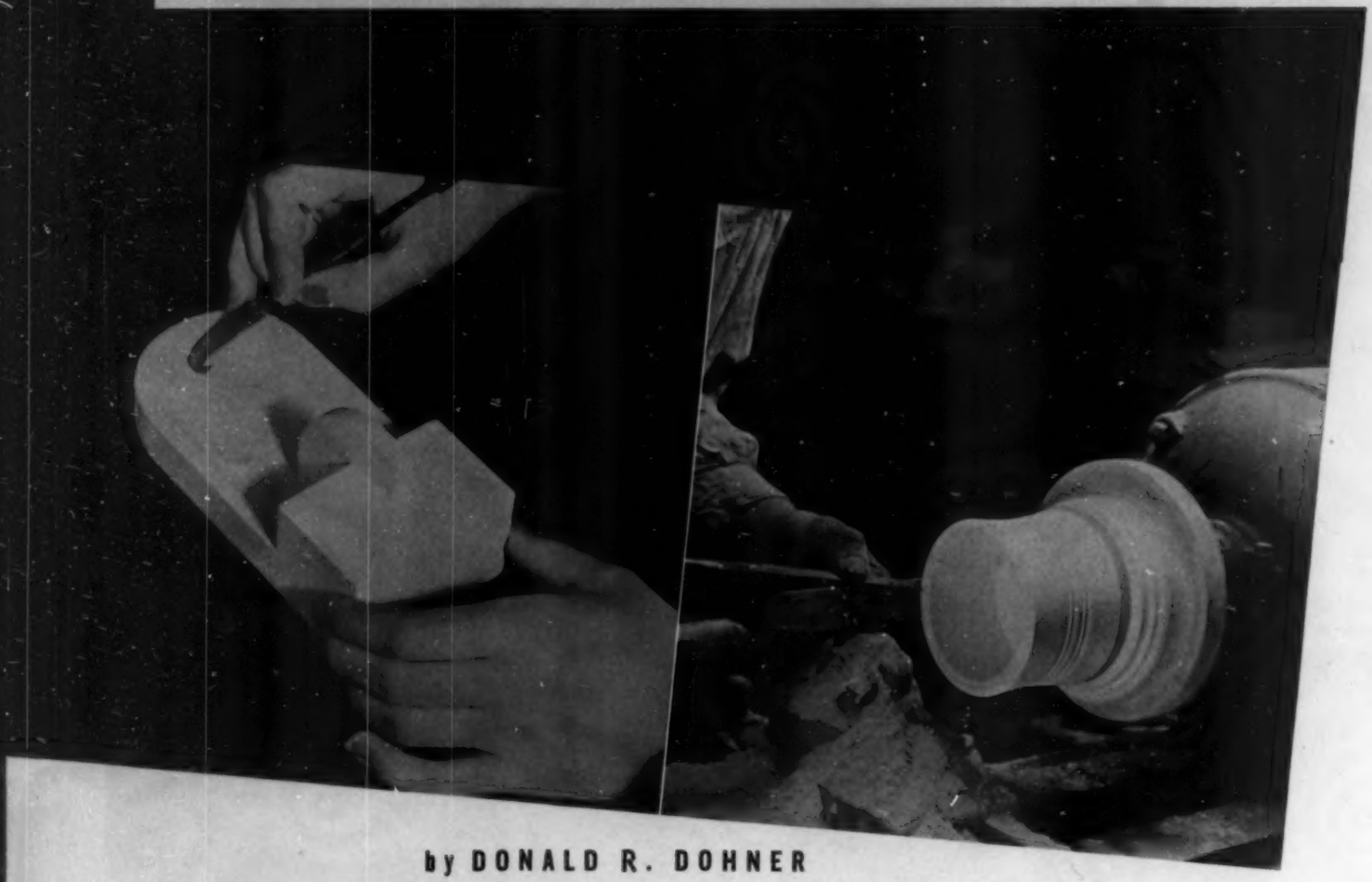
WHETHER CRUISING ABOVE THE CLOUDS AT two hundred miles an hour, or peacefully resting beneath the trees on the shore of some scenic lake, all travelers must eat. They must be supplied with equipment and dishes to eat with and from. Such dishes must be rugged and strong to withstand the shocks and knocks of cross-country and air travel. They must be clean and sanitary, but above all, they must be light weight.

That, no doubt, is why Pan-American Airways, United Airlines, and American Airways use plastic tableware on all their overnight transport planes. That is why you will find these bright and colorful dishes in the compact galleys of well-equipped trailers roaming around the land. They are easy to clean, light to handle, and not easily broken or chipped.

Even the railroads, now trying to popularize rail travel through lower rates, faster schedules, and attractive modern coaches, have taken steps to bring their dining service into line with these related economies. New cafeteria cars, offering meals at exceedingly moderate rates, have found this light weight plastic tableware both economical and practical to adopt. Travelers like this cheery table service with its plain simple surfaces and brilliant colors. It lends a note of gaiety and hominess to the meal wherever served.

Indicative of the satisfaction this plastic tableware gives in service, are the increasingly large orders being placed by some of these airlines to replenish and expand their supplies. They are being molded of Beetle by Northern Industrial Chemical Company.

INDUSTRIAL DESIGN AT PRATT INSTITUTE



by DONALD R. DOHNER

Mr. Dohner designed products for Westinghouse and others, then came to Pratt Institute as Supervisor of its Department of Industrial Design. In that position he contributes to the future, as well as the present, of an important industrial project

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INDUSTRIAL DESIGN, LIKE ADVERTISING, GREW out of mass production. Mass production calls for a fully developed design before manufacturing begins; fully developed not only as it relates to machine production, but in those aesthetic factors governing its appearance and appeal. With the aesthetic limitations inevitable with engineers, production technicians and workers on the one hand, and sales and advertising men on the other, there has risen an urgent need for the trained artist designer with an engineering and production view-point; one who can bring to the work of his technical and commercial associates, the essential elements of good taste and aesthetic invention that stimulate and achieve mass acceptance for current markets.

The course offered in Industrial Design at Pratt Institute is organized to meet the needs and requirements of industry in a realistic way that is unusual in the practise of any art school. The student is presented a series of typical and related *design experiences*, involving commonly used materials, tools, tool processes, fabrication, finishes, and costs. These limiting and conditioning factors are stressed in their relation to the fundamental principles of good design, and always with the contention that good design need not be compromised by machine production, provided the relationship between the two is fully understood and kept constantly in mind through all the steps in the development of the design.

A thorough study is made of the materials most commonly used in industry, such as the metals (steel, aluminum, copper, brass, and the zinc alloys), various woods, glass, clay, and the new synthetic plastics. Of these, and other materials, the designer must come to know the

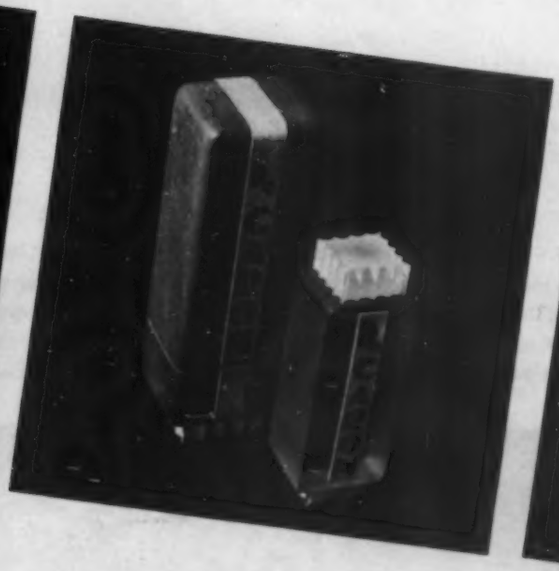
chief characteristics such as strength, weight, color, finished texture, and finishes that can be applied, workability and cost.

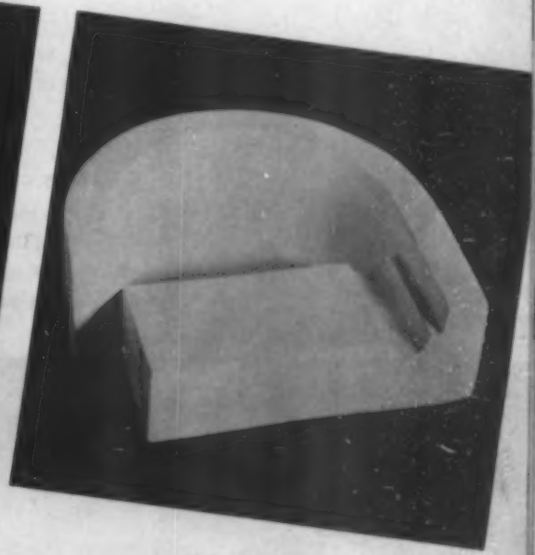
Two characteristics of materials that are of the utmost importance to industry are workability and cost. Not only must the industrial design student know how *workable* a material is, but also *how* it is worked and the resultant character imprint of the tool and process. This brings him to the fascinating study of tools and processes, and of production methods used in industry today.

Let us take one of the materials most commonly used in industry—metal. Metal can be spun, stamped, drawn, extruded, cast, die-cast, rolled, forged, and machined. Not all metals have the workability characteristics to permit all these processes. For some processes the metal must be fluid, for others heated, for others cold. The tools or machines for performing these processes vary greatly in size, complexity and cost.

It is obvious that no educational institution can acquire or maintain all of the equipment used in industry—few industries can. The Industrial Design department at Pratt Institute, however, has installed and maintains in operation, sufficient power equipment to bring home to the student, and crystallize in his mind, the influence and control exerted by tools and tool processes on his design. From time to time, experienced, skilled workers from industry are brought in for periods of two to four weeks to demonstrate processes and "produce" students' designs. The point I insist on making is this: we are training designers—not craftsmen or tradesmen.

While no educational institution can afford huge hydraulic presses for molding plastics, die-casting machines or presses and dies for drawing metal, there should at least be a realistic recognition of the importance of a thorough understanding of these processes, and steps taken to fully equip the student with this understanding. After lectures on the principles of die-casting, drawing and the processes involved in metal work, of the molding of plastics, the blowing and pressing of glass, and many other techniques, the student is taken on regularly organized and supervised trips through plants where these processes are a speciality. This important extension of the student's training is conducted by a graduate engineer who, after each plant visit, goes over all the details of the process seen. *(Continued on page 62)*





The three larger photographs on these two pages illustrate how students are taught to shape models mechanically and by hand, then assemble them as a completed design. Below, are three designs executed (left to right) in cardboard, cast resin, and plaster. The use of cast resin in the De Caron Model gives both the feel and appearance of glass in which the bottle will be eventually produced

FROM HOURS to MINUTES

by EVE MAIN

In the beginning the jeweler's art was a tedious task which modern materials and methods have made comparatively rapid and simple

THE DESIRE FOR PERSONAL ADORNMENT IS THE FOUNDATION UPON which has been built one of the oldest and most important industries—the making of jewelry. All through the ages, man has fashioned trinkets for his women folks and himself from materials supplied for the most part by nature. Prehistoric man found it necessary to devise some method of fastening his clothing of skins, and because bone was nearest at hand and familiar to him, he skillfully adapted it to his needs. His bone fastenings were first of all practical, then carved with original designs inspired by his surroundings which though crude, possessed a natural beauty.

Brooches and rings were the first jewels made from metal, followed by necklaces, bracelets, chains and carved stones. Different countries have contributed their interpretations of personal ornamentation. Egyptian goldsmiths prepared massive gold bracelets for the Queen of Zer in 5400 B.C.; Assyria favored bronze jewelry elaborately decorated; the Minoan gems of Crete, 1600 to 1400 B.C. include necklaces and beads cut from amber, amethyst, agate and crystal; the best Greek Jewelry dates from the 5th Century B.C. and includes pieces of delicate filigree and others enamelled in color; Persian women bedecked themselves with necklaces of pearls, lapis, turquoise, emerald and jasper; Anglo-Saxon craftsmen worked in gold filigree and enamel; Middle Age jewelry was engraved, inlaid and set with all the precious stones. During the Renaissance, the jeweler's art became increasingly important in Italy, France, Germany and England.

There have probably been fewer radical changes in the jeweler's art than in any other industry because the purposes for which jewelry is used are the same that have existed throughout the ages although styles, of course, have kept abreast of other fashion trends. Old-time craftsmen worked upon their metals and stones with primitive tools. Each piece required a great amount of painstaking labor and the consumption of much time and concentration. Later, laborious hand methods were augmented and supplanted by machinery, which made possible more rapid production and brought attractive pieces within the reach of a greater range of people. This tendency toward using machinery has perhaps represented the greatest change in all the history of jewelry manufacture and the principal difference between ancient and modern art lies in the craftsmanship and tools the workers were able to bring to bear upon raw materials. The materials used have not changed a great deal except for the introduction of new ones to (*Continued on page 70*)

1. Cast resin jewelry is designed by actual fabrication. 2. Buttons and buckles are sliced from a rod. 3. Designs are cut by pressing material against revolving grinder. 4. The production line. 5. A number of thicknesses are jigsawed at one time. 6. Machine carving a buckle. 7. A bracelet. 8. Polishing the edges roughened by cutting. 9. Beads are pierced for stringing on a foot-treadle machine. 10. Sorting and sizing beads which have been turned and polished

Craft jewelry from cast resin, designed to fit in with contemporary style trends. Strings of graduated beads in pastels and bright colors highly polished, are popular for beach and town wear with light spring and summer ensembles. Deeply carved hinged bracelets, huge clips and brooches, and dainty earrings add zest to costumes for all occasions. The pieces are turned out in vast quantities by skilled craftsmen aided by machines especially constructed for the fabrication of cast resin jewelry. Low material and low fabrication costs make it possible for women to afford several sets or pieces to complement daytime and evening apparel

GETTING FULL VALUE INTO PLASTIC PARTS

(EDITORIAL COMMENT)

THE GENERAL ACCEPTANCE OF PLASTICS AS fundamental manufacturing materials throughout industry has brought about an increasing disregard of the inherent properties of the various grades of plastic material. Manufacturers have a tendency to decide "We'll make it of plastics. Call in a molder, and get a price!" without frankly discussing *all* the factors incidental to the specific job these plastics are going to be called upon to do. Our mention of "various grades of plastic materials" is made without reference to trade names. All suppliers of plastic materials make various grades of their product with specific properties which should be more thoroughly understood and discussed by those purchasing and handling them before orders are placed.

Custom molders, like other manufacturers, are in the habit of agreeing to specifications on finished parts. It is a common thing for size gages to be used on molded parts, and wherever large flat surfaces are encountered, there is usually an accompanying specification requiring that they be flat within certain limits. There is also usually a specification on appearance, but that as a rule might be quite general. So often do molded parts have excess strength, water resistance, or other special properties, that both buyer and molder are inclined to become careless in reviewing these requirements when arranging the specifications of a job. These requirements, however, have a bad habit of popping up after the job is in production, causing considerable embarrassment to all concerned. Claims and counter-claims result, with a net loss that is almost always avoidable.

NO ONE KNOWS HOW MUCH MONEY IS LOST over a period of time because molder and customer have not come to a complete understanding of just what is going to be delivered in the way of quality. But we are told that the sum is tremendous. It involves not only the actual out-of-pocket loss concerned with one job or another, but also the excessive cost of straightening out production difficulties or producing quality that was not understood to be originally required.

Such situations are often encountered through a "wishful" attitude. The customer hopes that the part he is ordering is going to be suitable because the material being considered has a good reputation for quality. The molder feels confident he is going to deliver satisfactory quality because he has done so with little effort on many previous occasions. It probably seems unnecessary to get down to the discussion of details of finished characteristics that can be so often taken for granted—yet that is just where the trouble lies. Failure to do so, is the cause of this immense loss annually to all concerned in the plastics industry, including those who use the parts.

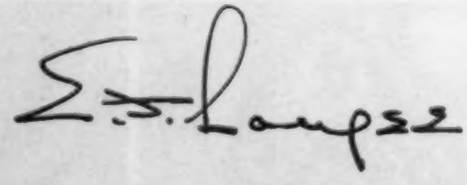
Lack of experience may excuse the client, but the molder all too often is sticking his head in the sand. Bitter experience will teach them both that all the characteristics expected in the molded part should be laid out and examined in order to make certain the part is going to stand up after it has been finally assembled and put into use.

There is a common and careless habit in the production of molded parts, of looking at the piece as it comes from the mold and deciding by its appearance that all its properties are correct. Modern molding materials combine high mechanical strength, water resistance, dielectric strength and insulation resistance with fine molded appearance. Most of the time if the molded appearance is satisfactory, the other properties are satisfactory, too. But it is entirely possible to produce pieces that look all right which may be deficient in one or more of the other essential requirements.

Uniform strength is easy to get in a molding material that is properly fabricated, but getting proper fabrication can become a complicated matter since mold designs vary to such an extent. There is only one way to determine whether a piece has come out of the mold with all the essential properties it is supposed to embrace, and that is to test for the properties desired, and to do so at regular intervals during production.

IF THROUGH FAILURE TO CONSIDER AND FIX specifications for finished characteristics of pieces, or even worse—if a molder fails to make sure during production that the necessary finished characteristics are being produced, and ships out pieces unsuitable for the customer's use, he may destroy not only the customer's faith in his own concern but also in the use of plastic materials themselves.

With proper precautions this loss of profits and confidence need never occur. The wise producer, as well as the wise purchaser of plastic parts, should begin with a frank discussion of every phase of the job considered, and end with definite specifications which, once agreed upon, can be rigidly followed.



1. Pyroxylin model of the 200-inch telescope mounting 1/32 scale. J. Ormondroyd, engineer in charge of construction of the mounting is pointing to a 1/32 scale model of a man which shows the relative size of the telescope. 2. W. M. Keenan, of the Experimental Laboratory, Westinghouse Elec. & Mfg. Co., constructing the pyroxylin model. This picture indicates the use of hypodermic needle containing acetone to cement the various parts together

VISUALIZING FOR CONSTRUCTION

Easy to cut and cement together, plastics offer the designer and engineer a convenient material for making models

STRUCTURAL DESIGN HAS LONG SINCE BEEN visualized in advance through the building of small scale models. Industrial design, too, has found this an eloquent means of expressing ideas in terms that can be understood by executives who must pass upon their appearance and upon the appropriations which make them possible. Materials for the purpose have run the gamut from modeling clay, through wood, plaster of Paris, to the more recent transparent plastics which offer advantages in appearance as well as in studying stresses by polarized light.

The model illustrated is for the 200-inch telescope mounting eventually to be erected at Mount Palomar, in California. The model is made completely of pyroxylin sheets cemented together by the use of acetone. Acetone dissolves the pyroxylin and forms a welded joint. Wherever a particularly strong joint is desired, pyroxylin is dissolved in the acetone making a rather heavy cement which is then applied to the joint. It was found that the best and cleanest joints were produced by first making a good, tight fit between the two mating surfaces and then applying acetone by means of a fine hypodermic needle. Capillary attraction apparently pulls the acetone in between the surfaces and the joint is dried and set in a few seconds.

The scale of the model is 1/32. That is to say, every linear dimension on the real telescope is reduced to 1/32 of its true value in the (*Continued on page 57*)

PLASKON

PEN FILLER

Present day ornament on the desk of many a big-wig and punctilious secretary is the Terry Penfiller—a mechanized inkwell which flushes and cleans your pen every time you fill it and fills your pen better than the pen's own mechanism. It is perfect for "dip" pens too, because it seals the ink against dust, dirt, and evaporation.

The case of the Penfiller is made of Plaskon for eye appeal and for protection of the interior glass reservoir holding the ink. The fluted design and the recessed chamfered corners which provide a sure, non-slip grip, are features made possible by Molded Color's "moldability."

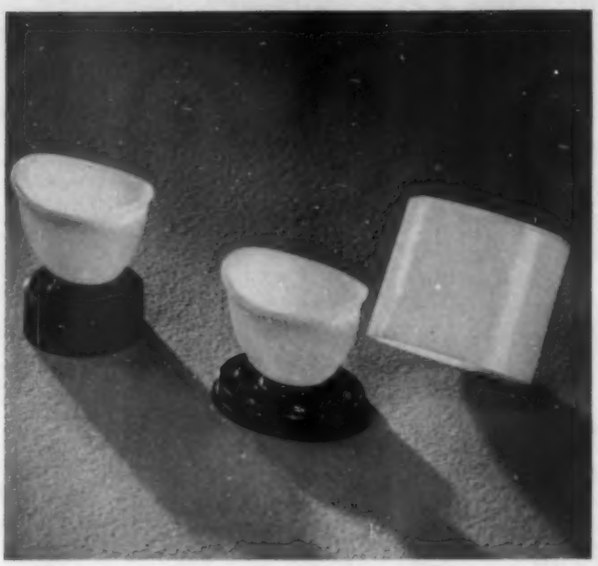
Molded in various Plaskon colors by Reynolds Molded Plastics, Jackson, Michigan.

Plaskon fittings, internal and external, in the 1937 Kelvinator, not only add to the attractiveness and appeal of the unit, but are unaffected by varying conditions to which they are subjected. The exact uniformity of these Plaskon parts speeds Kelvinator production by simplifying assembling operations at the manufacturer's plant. The pleasant surface, permanent finish and color of Plaskon fittings are very desirable properties of parts which are being handled constantly.

Kelvinator Plaskon parts: Crisper drawer fronts—Interior light shade—Thermometer—Shelf studs—Knobs on control unit, defrosting device, ice cube chamber door—Hinge covers—Door handle.

REFRIGERATOR FITTINGS

MAY 1937



EYE CUPS

Reading from left to right in the picture you see a combination closure and eye cup used on bottles, an eye cup, and the dust cover for the latter. Separately and together they are doing more for eye-wash lotions than any other recent merchandising idea. On the retail market, the covered model created a boom which is surprising even the makers, Colt's Patent Firearms Company of Hartford, Connecticut.

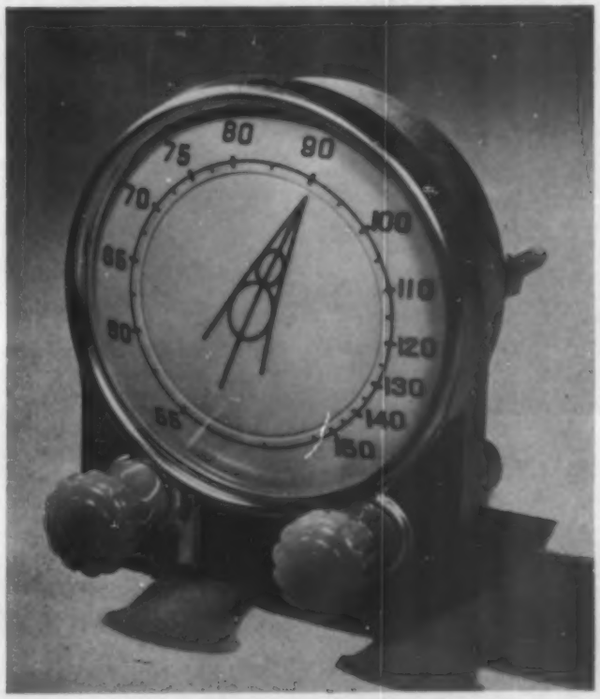
According to Colt's the instant appeal of Molded Color is playing a definite appeal in this success. Eye cups in color were a novelty idea which quickly became a profitable reality using color-fast, sanitary Plaskon. Why not try refreshing your product with beautiful color? It pays.

A Ford V-8 and a Ford radio are an ideal combination for happy motoring.

The large, illuminated, non-glare station dial on the newest Ford radio is made of Plaskon. It is attractive, easy to read, and designed in harmony with the other instruments on the panel.

Hundreds of different translucent molded parts have been placed in use since Plaskon pioneered this development. The dome lenses on the overhead fixtures in the 1937 Ford V-8 are an appropriate example. Let us show you what is being done with translucent molded parts.

RADIO DIAL



PLASKON COMPANY
INCORPORATED

PLASTICS' PROGRESS

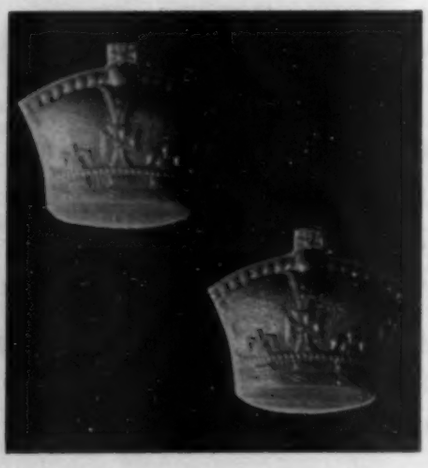
1. This man-size advertising ashtray is molded of Makalot by Northern Industrial Chemical Co. for American Analine Products Inc. Company name and advertising message are molded in

4. Robert Heller designed this modern toaster for A. C. Gilbert Company. occupies small space, is chrome plated and has convenient door handles of Bakelite. The base is black enamel

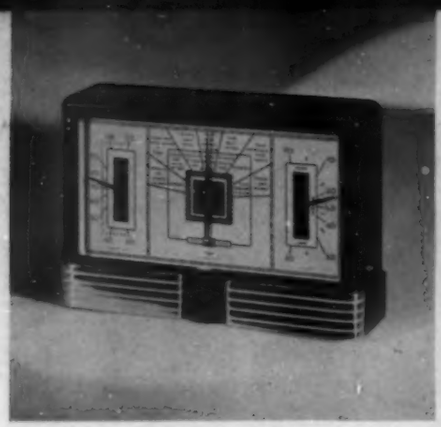
2. Cetec wire connectors molded by General Electric for Ideal Commutator Dresser Co. Connection is made when the wires are firmly inserted and can be broken only by untwisting them

5. The vacuum principle of Terry Penfiller Co.'s inkwell embodies a soft rubber cap, and spring actuated pump. Light colors, Plaskon, dark colors Durez — Reynolds Molded Plastics

3. Erasures are neatly and quickly made with this Motoraser. The molded housing fits the palm of the hand and a convenient switch controls it instantly. Made for Kueffel and Esser



6. Coronation emblems are enjoying their day of popularity in dress trimmings and other accessories, so Synthetic Moulded Products, Inc., molds these small crowns in different colors of Beetle

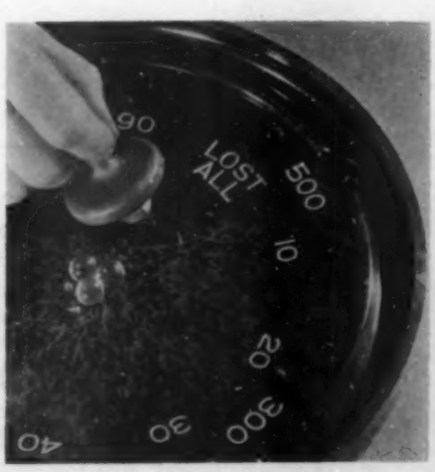


7. Taylor Instrument Company adds temperature and humidity indicators to its former Stormoguide, all in one compact unit. Molded of Durez by Diemolding Corporation

10. Molded Bakelite handles on this modern chromium cocktail tray assure a firm grip and give a pleasant contrasting effect. Molded for Lehman Bros. by Boonton Molding Co.

8. Gray Plaskon gives character to this new timer which Auburn Button Wks. Inc. molds for Westinghouse Electric Co. The timer switch is easily set by molded knobs. Designed by Paul Gaston Darrot

11. Associated Attleboro Mfgrs. Co. molds this smart compact radio in a variety of colors from Beetle for Emerson Radio Co. It is 7 1-2 in. by 7 1-4 in. by 5 3-4 in. and weighs but six pounds



9. Topspin is molded of mottled Durez by B. F. Oshei, Inc. Glass balls drop into molded-in recesses when knocked out of a concave center by the impact of the spinning top

12. This group of kitchen conveniences is the product of M. H. Rhodes, Inc. The timer cabinet is molded by T. F. Butterfield, the salts and peppers by the Richardson Co. Both are Beetle

1

2

1. The molded nozzle tube, designed for silent, scratchless filling operation and elimination of gasoline drip, has longer life and greater flexibility than flexible metal tubes

2. Variable thread sizes on this nozzle tube enable it to be used on any size gasoline hose with complete gasoline seal

CAR OWNERS WILL LIKE THIS

by T. F. HARRAGAN

Molded of hard and soft synthetic rubber, this gasoline nozzle will neither scratch nor drip. It goes deeply into the tank and permits rapid filling

PRIOR TO THE DEVELOPMENT OF A SOFT NOZzle tube for gasoline service station hose, filling station operators used nozzle tubes of flexible metal construction. By the manufacturers, and by the more-than-a-million operators of filling stations, this type was considered essential in view of the universal opinion that metal alone could withstand the attacks of gasoline solvents upon that product. (Natural rubber deteriorates rapidly on exposure to gas, oils, solvents, etc.) Regardless of that fact, many complaints were received because these nozzles marred fenders and accessories in the process of servicing cars; the rigidity of these tubes cost time by compelling attendants to discharge gas slowly due to the inability to thrust the tube deep into the curved elbow tank spouts; and because the inside metal spiral on the nozzle tube dripped gasoline after the valve had been shut, with the consequent loss of considerable gasoline.

The idea for this Flex-Flo nozzle tube, which is molded of Thiokol oil-proof synthetic rubber by the Molding Division of the Gates Rubber Company, was conceived soon after the entrance of that company into the field of synthetic rubber gasoline hose. Much emphasis was placed on the continual breaking (*Continued on page 60*)

Stock molds

SHEET THIRTY-THREE

Plastic boxes are in constant demand and those illustrated here are available in various colors, without original mold cost. Samples will be sent to executives who request them on business stationery. Please mention both sheet and item numbers when writing to secure these samples

---

435. Round black tray (10 inch diameter) with cover (8 3/4 in. diameter, 2 5/8 in. high) for packaging fruit cake or other food items where reuse value of the package is an advantage

442. Box 10 in. long, 3 7/8 in. wide and 1 3/4 in. inside depth. The lift-off cover of a contrasting color has a raised panel and embossed design. Overall height 2 1/2 inches

443. Semi-circular box with side legs to prevent rocking. 3 in. long, 2 3/4 in. wide and 1 1/2 in. inside depth. Lift-off cover has a rectangular handle

444. Box 6 1/2 in. long, 3 in. wide, and 1 1/8 in. inside depth. Hinged cover of a contrasting color has a molded design and the sides are fluted

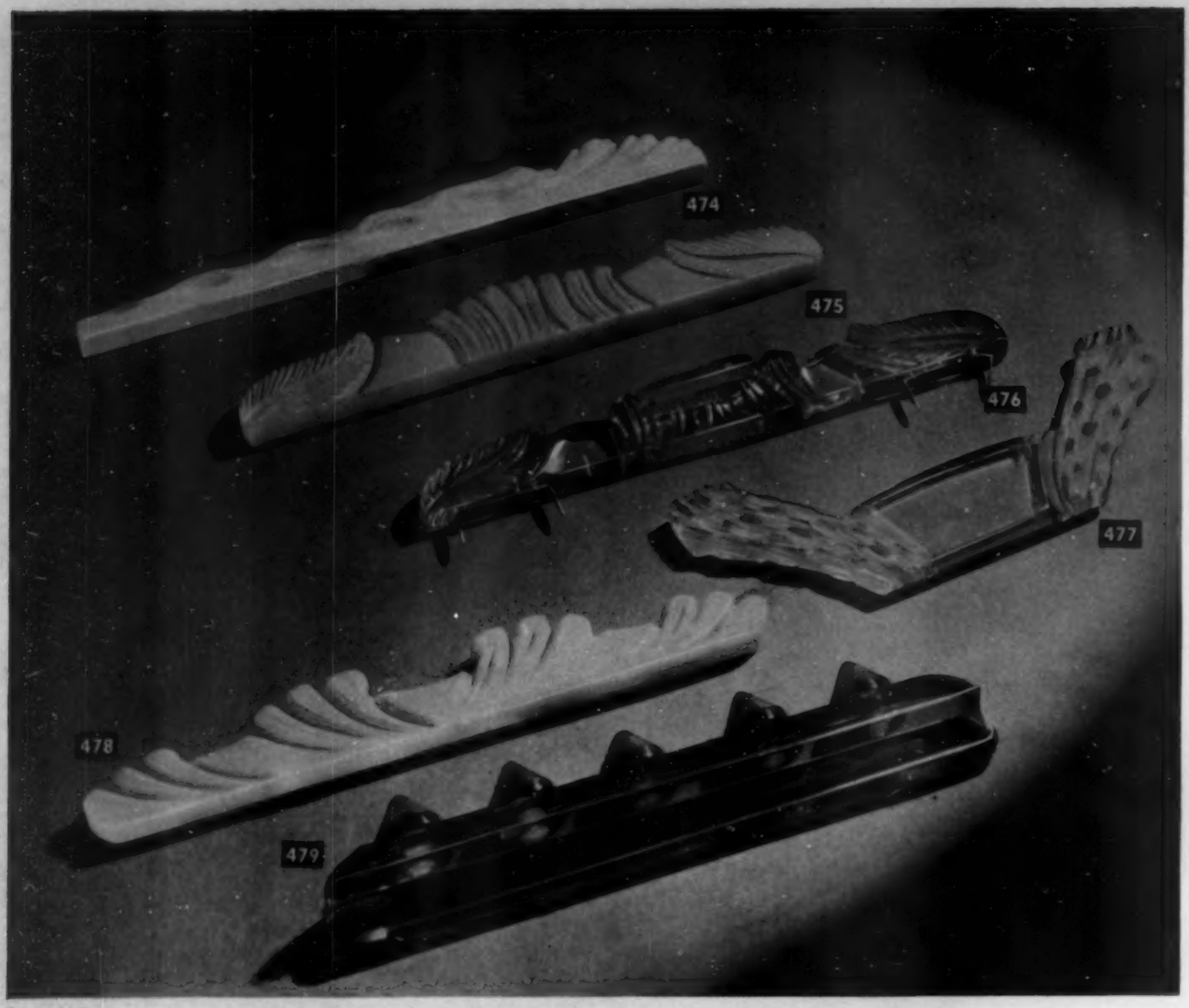
445. Ring box with black base 1 3/16 in. square, 9/16 in. high. Decorated green top 1 5/16 in. square, and 1 in. high is geometrically designed

446. This ring box has a raised and recessed geometrical design on the cover and sides

447. Rouge box with contrasting base and top has a 1 in. diameter, 3/8 in. inside depth. Quarter-turn cover, 3/16 in. high

448. Box with lift-off cover and elaborately embossed design. 4 1/2 in. long, 3 3/16 in. wide, 3/4 in. inside depth. Overall height 1 3/8 inches

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits.



CAST RESIN BAG TOPS

SHEET THIRTY-FOUR

These bag tops are not molded but are stock items made from cast resins and are available in a wide variety of colors and designs. Interested executives should write on business letterhead to obtain the manufacturer's name.

474. Tapered white bag top, deeply carved. 7 3/4 in. long and 5/16 in. thick

475. Maize colored top 7 in. long and 3/8 in. thick with carved center and ends

476. Transparent top with attachment clamps and opening for strap handle, 7 1/16 in. long and 5/16 in. thick

477. Ends of this transparent bag top are carved but unpolished, giving a ground-glass effect. 6 in. overall, 3 in. at top and 5/16 in. thick

478. Maize top, 7 in. long and 3/4 in. thick. Deeply carved

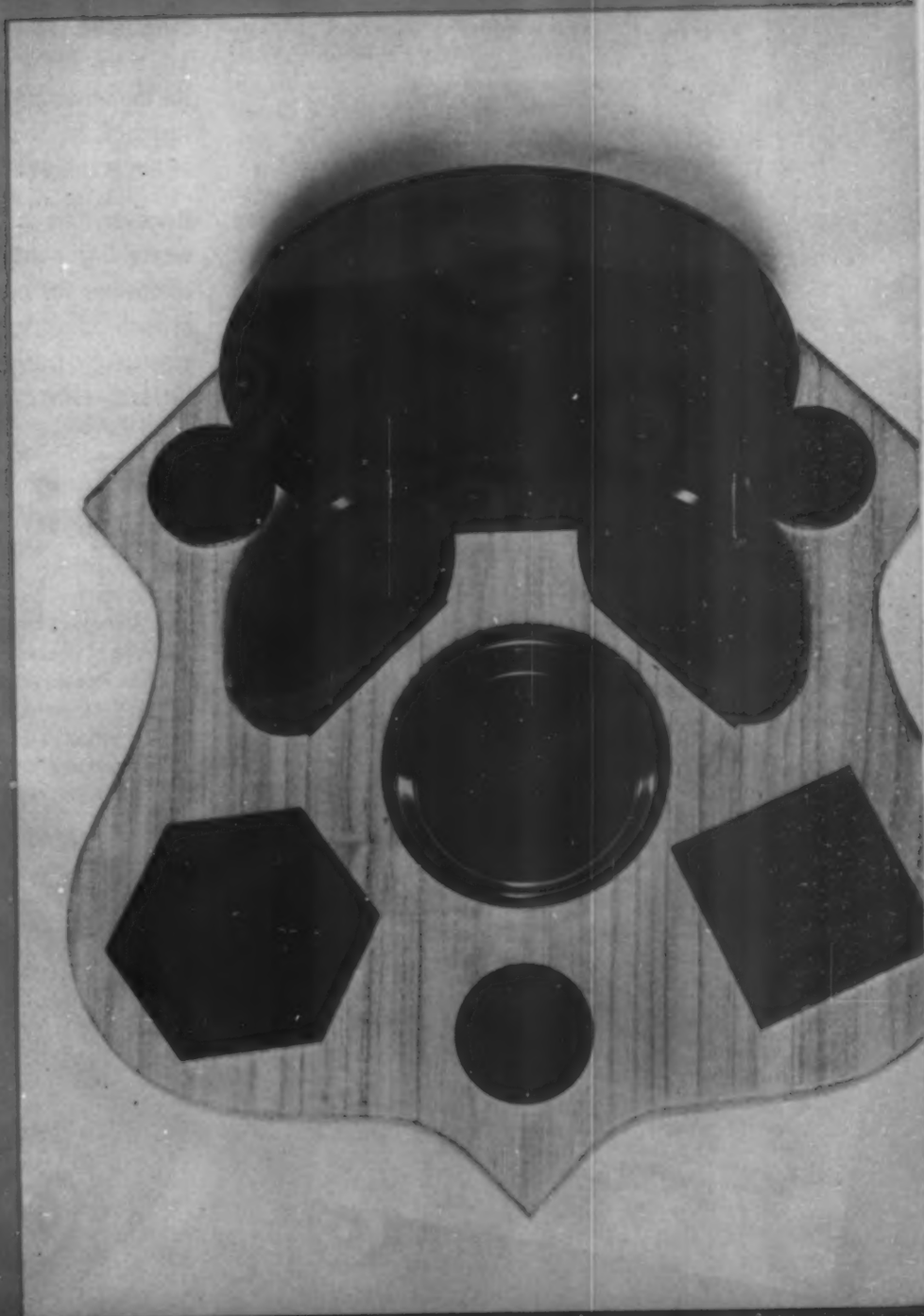
479. Transparent top, tortoise shell pattern, with five turned knobs as decoration. 7 in. long, it is cut from 3/4 in. stock, one half of which is cut with a 3/8 in. rabbet

Address all inquiries to Stock Mold Department, Modern Plastics, 425 Fourth Avenue, N. Y. C. All molders are invited to send samples from stock molds to appear on this page as space permits.

MODERN PLASTICS

TECHNICAL SECTION

DISPLAY OF LIGNIN PLASTIC—SEE STORY PAGE 46



LOVELY

. . . *to look at* . . .

W. G. Shelton Co. selected Durite for the circular collar of their hair dryer primarily because of its uniformity and striking appearance. Beauty shops, naturally, prefer things that are pleasing to the eye.

W. G. Shelton Co. in designing their hair dryer also considered the fact that this rim would come in direct contact with the user, must be comfortable and conduct the minimum amount of heat. Today hundreds of satisfied users of the Shelton dryer are universal in their praise of the practical and desirable features of the Durite rim.

However, this is but one of thousands of applications where Durite has been the specified choice of leading companies for many years. If you have never learned of their advantages, write and ask about these unusual plastics by Durite, the exclusive producers of phenol-furfural resins.

DURITE *Plastics*

TRADE MARK REG.

Frankford Station P. O., Philadelphia, Pa.

A DIVISION OF STOKES & SMITH COMPANY

A FEW REASONS WHY DURITE PLASTICS WERE CHOSEN FOR SHELTON DRYERS

1 *The glossy, gleaming finish of Durite makes an invaluable sales appeal. In a rich deep black contrasting with the sheen of chromium plate Durite adds striking beauty to an assembly.*

2 *Durite transmits heat slowly, and its texture hot or cold is pleasant to the touch. It is also unaffected by moisture, oils, alcohol and other common solvents.*

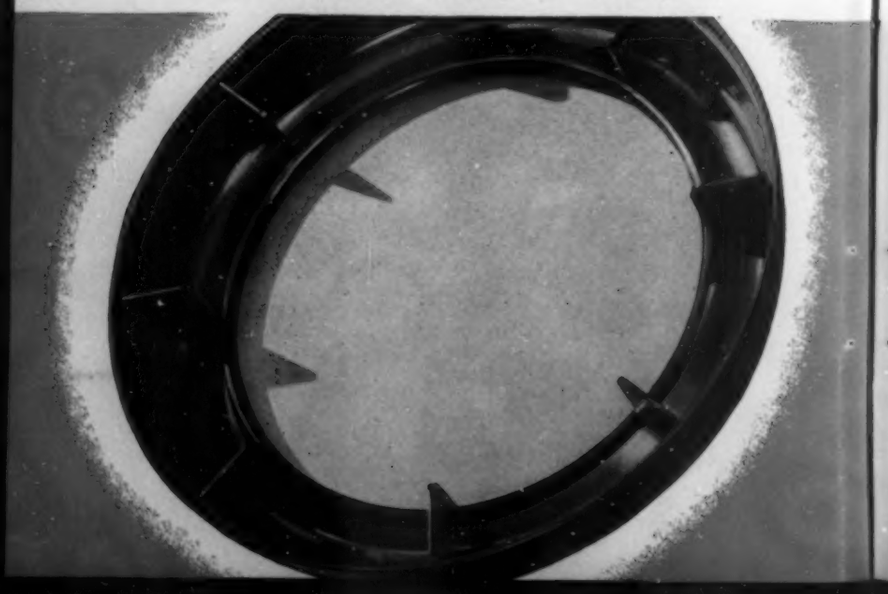
3 *Durite parts of proper design can be light in weight yet of surprising strength, capable of taking much abuse from careless handling.*

4 *Assembly is simplified by the use of a light weight plastic material. An accurate fit for each unit is accomplished by controlled precision molding, resulting in a uniform, snug fit over the metal flange.*

5 *Properties inherent in Durite make the embodiment of revolutionary features of design practical for large scale economical production.*

★

Molded Durite Rim Used on Shelton Dryer



SYMPOSIUM ON ORGANIC PLASTICS

by GORDON M. KLINE

ANOTHER SUCCESSFUL MEETING OF PLASTICS chemists was held on April 14 and 15 at the Chapel Hill convention of the American Chemical Society. Papers covering synthetic resins, natural resins, and cellulose plastics were presented before approximately 200 of the more than 2000 chemists in attendance.

An invitation was extended by the Division of Paint and Varnish Chemistry to the plastics chemists to affiliate with it as an Organic Plastics Section. The by-laws of the Society require that any group of chemists interested in a particular field must hold six sectional meetings at the semi-annual conventions before divisional status can be obtained. After due consideration of other possibilities with respect to the formation of a plastics group within the American Chemical Society, it was unanimously decided by those present, representing many laboratories interested in this subject, to accept the above invitation. G. M. Kline was designated to be chairman of the new section and to cooperate with C. G. Sward, secretary of the Division of Paint and Varnish Chemistry, in the preparation of the program for the Rochester meeting in September. Ninety chemists enrolled as members of the Organic Plastics Section which is an excellent showing. It is felt that many more chemists within the industry who belong to the American Chemical Society will wish to aid this new section by becoming members of it. It is suggested that these individuals send in their names to G. M. Kline, c/o National Bureau of Standards, Washington, D. C., so that an idea of our numerical strength may be obtained.

It is necessary to begin the consideration immediately of papers for presentation at the fall meeting. It is very desirable to include papers on both the theoretical and applied aspects of synthetic and natural resins, cellulose derivatives and protein plastics. Anyone who will be in position to contribute to the program is requested to send in the title and abstract of the paper soon.

Abstracts of the papers which were given as part of the Symposium on Organic Plastics held in cooperation with the Division of Paint and Varnish Chemistry at Chapel Hill, North Carolina, are presented below.

STRANGE ALKYD RESINS by A. G. Hovey. Resins produced by the reaction of two monohydroxy monocarboxylic acids were discussed. Typical examples cited were the reaction products of lactic and salicylic acids and lactic and citric acids. The condensation of aliphatic hydroxy acids such as lactic, citric or tartaric acid, with themselves, as shown by a drop in acid number, was discussed. The aromatic hydroxy acids did not form resins by condensation with themselves or with another aromatic hydroxy acid. Resins can also be produced from such polyhydric alcohols as the natural carbohydrates, erythritol, and gluconic acid. The tendency of these materials to carbonize was stated to be related to the presence of aldehyde or other reducing groups rather than to the proximity of the hydroxyl groups. The prediction was made that eventually cellulose and other complex carbohydrates will be used as direct raw material for alkyd resins. "Mirror-image" alkyds, i. e., those prepared from aliphatic polybasic acids and aromatic dihydroxy alcohols were described, a typical example being catechol-tricarballylate resin. A glycol-tricarballylate resin corresponding to the glycerol-succinate type was discussed. Other resins described included those prepared from glycerol and the isomers of ortho phthalic acid, glycerol and tetrachlorophthalic anhydride, and glycerol, phenolphthalein and formaldehyde. The author called attention to the fact that in reacting glucose and other sugars with edible polybasic acids of fruit origin such as citric acid, man has been making candy-alkyd resins for ages.

SHELLAC, THE PARENT OF MODERN PLASTIC RESINS by Wm. Howlett Gardner. Analysis of the historic documents of the ancients indicates that the aboriginal tribes throughout India employed shellac as a plastic resin several thousand years ago in the coating of a wide variety of household goods. Articles were also made from cast shellac in the earliest times, but our modern industry dates from the close of the past century when Berliner discovered the advantage of using shellac in making talking machine records. The electrical industry is one of a group of consumers using shellac in the manufacture of insulation for high voltage transmission. Two large thirty-foot laminated shellac insulating cylinders were used in the construction of the electro-static generator at the Massachusetts Institute of Technology, which delivers over thirty kilowatts at 10,000,000 volts. Shellac has a combination of properties which have not been duplicated by synthetic resins. The rate of setting under heat and mechanical properties at elevated temperatures are such, however, as to place it at a disadvantage where speed in production is of primary importance. It has been discovered that a wide variety of chemicals when incorporated with shellac accelerate its rate of setting. Shellac contains a natural plasticizer which prevents the setting from assuming the rigidity obtained with some of the synthetic resins. A process has been developed in England to remove this portion of the resin. Further studies in the development of shellac molding powders are in progress.

ETHYLCELLULOSE, PROPERTIES AND USES by William Koch. The method of preparation and the

outstanding properties of commercial ethylcellulose of 47 to 48 percent ethoxy content were discussed. The uses described included its application in plastics, as a pigment grinding base, flexible coatings for paper, cloth and leather, in laminated glass and as an electrical insulant. Tables of data were shown which indicated the compatibility of ethylcellulose with waxes, tars, and similar compounds, the effect of its addition upon the melting points of waxes, its compatibility with plasticizers and resins, its solubility in organic solvents, some typical pigment dispersions in ethylcellulose plastic prepared on a differential two-roll mill, its electrical properties, and miscellaneous properties pertaining to its use in plastics and lacquers.

EVALUATION OF THE PROPERTIES OF ETHYLCELLULOSE FILMS BY THE USE OF LOAD-ELONGATION CURVES by T. A. Kauppi and S. L. Bass. The behavior of thin films under the application of stress was used to evaluate the mechanical properties of ethylcellulose and its compositions with plasticizers and resins. Ethylcellulose by virtue of its great flexibility readily lends itself to this type of testing. By means of curves showing the amount of stretching produced with increasing loads, the authors were able not only to determine the ultimate tensile strength and elongation of the materials, but also to obtain a comparison of their toughness, flexibility and hardness as well. The films of ethylcellulose show a pronounced resistance to stretching when the load is first applied. Up to a relatively low degree of stretch they behave as entirely elastic materials. At a certain load, which was found to be characteristic of each composition tested, the films suddenly yield and begin to stretch very rapidly. Further applications of load are entirely taken up by stretching until the film either breaks or develops a new resistance to stretching. In the latter case the films break at a much higher load and exhibit increased tensile strengths. This strengthening effect on stretching, and the degree of elongation at the breaking point of the film, when taken together with the yield-point, serve to measure the toughness of the ethylcellulose film. The ability of the film to stretch indicates its flexibility. Ethylcellulose films show an unusually high flexibility and toughness compared to those of cellulose nitrate and cellulose acetate. The yield-points of all three cellulose derivatives occur at relatively low but comparatively constant percentages of deformation or stretch. Since hardness can be defined as the resistance to permanent deformation, the yield-points of the films may be used to measure their hardness. Compared to cellulose acetate and cellulose nitrate, ethylcellulose films are much less hard. The hardness was found to be unaffected by the viscosity grade used. Flexibility and toughness, however, increased with the viscosity of the material. The load-elongation curves proved valuable in comparing the effects of the addition of plasticizers or resins to ethylcellulose. The better the solvent power of the plasticizer, the higher was the observed yield-point of the plasticized film. Increasing the molecular complexity in a given plasticizer series raises the yield-point of the plasticized film. Plasticizers having low solvent power produce films of low flexibility at relatively small concentrations of plasticizers. At high concentrations of a plasticizer, flexibility seems to depend more on molecular size or complexity than on solvent power. The higher the viscosity of the ethylcellulose, the greater is the flexibility obtained with a given plasticizer, and the greater is the secondary strengthening effect on stretching.

THE PERMEABILITY OF ORGANIC POLYSULPHIDE RESINS TO HYDROGEN by T. P. Sager. The ability of films of organic materials to impede the passage of gases is of importance in connection with many of our modern products and particularly balloon and airship fabrics, where thin films and large surfaces are involved. A comprehensive study indicates that products resulting from the general reaction between organic dihalides having —CH_2Cl terminals and metallic polysulphides have relatively low permeability to hydrogen and helium. The lowest permeabilities are obtained with products having four atoms of sulphur in the primary molecule. A closely-woven cotton fabric coated with an organic polysulphide resin to the amount of three ounces per square yard will allow hydrogen to permeate at the rate of about 0.01 cubic foot per square yard in 24 hours. A fabric having the same weight of coating of rubber will have a permeability of nearly 70 times that of the synthetic material. If it is assumed that a single cell in an airship may represent 6000 square yards of fabric, the loss of lifting gas by diffusion alone for a rubber coating would amount to 4200 cubic feet in 24 hours, whereas an organic polysulphide resin coating would permit only 60 cubic feet to escape. Factors affecting the limitations of weights of coatings and the mechanism of the permeation were discussed.

THE USE OF PIGMENTS, LAKES, AND COLORING MATERIALS IN PLASTICS by J. H. Clewell and H. W. Paine. Some of the pigments used in coloring plastics are Prussian Blue, certain indanthrene vat dyes, and alizarine lakes (dyestuffs precipitated on alumina hydrate). These pigments are insoluble, but if the plastic is not too thick a nearly transparent effect can be obtained by their use. Opaque pigments include zinc oxide, titanium dioxide, ultramarine, cobalt blue, carbon black, ochres, cadmium sulphides, and lead chromates. Of the available soluble dyes, the familiar triphenylmethane colors are the brightest and can be dispersed in plastics with ease, although they have the disadvantage of poor resistance to sunlight. The azo colors, as a group, are somewhat faster to light. Tortoise shell imitation is made by combining amber and brown on the rolls while in a soft condition. Onyx effects are obtained by first rolling several different colored plastics together, then cutting them into small pieces and reconsolidating in the baking or pressing operation. The material for imparting pearly sheen may be (*Continued on page 59*)

GLYCEROL IN PLASTICS

by MILTON A. LESSER, B.Sc. and GEORGIA LEFFINGWELL, Ph.D.

AMONG THE BASIC RAW MATERIALS FOR THE manufacture of synthetic plastics and resins, glycerol plays a rapidly growing part. Millions of pounds of glycerol are annually consumed in the production of these modern substances and the amount is steadily increasing. Examination of the literature shows that numerous patents have been granted not only in this country but also in Great Britain, Canada, France, Germany, Russia and Japan for synthetic resins made with glycerol. Many studies have been made of these resins, in one instance being sponsored by a government.[1]

The most important of these glycerol-containing synthetic resins are those of the alkyd or "Glyptal" type. These are, broadly, the condensation products of a polyhydric alcohol and a polybasic acid. Practically, they are the products of the reaction between glycerol and phthalic acid or phthalic anhydride at elevated temperatures. Glycerol is an alcohol containing three hydroxyl groups. The pure form is a water-white, syrupy liquid, heavier than and miscible with water, and having a specific gravity of about 1.249. It is very hygroscopic, being able to absorb moisture from the air. Glycerol is soluble in alcohol, but insoluble in most other organic solvents. Phthalic acid is a colorless, crystalline substance, very soluble in alcohol, fairly soluble in hot water and slightly soluble in cold water. Phthalic anhydride is prepared from phthalic acid by heating and appears as white, lustrous needles. To these basic ingredients are added one or more other materials, the nature of which is determined by the final type of resin desired. The added materials include such varied substances as vegetable oils, for example, linseed, castor and chinawood oils, and their fatty acids, rosin, abietic acid, succinic acid, stearic acid, waxes, butyl alcohol, high molecular weight alcohols and many others.

The physical properties of the alkyd resins vary with the time and conditions of heating and with the purity and proportion of the ingredients. These factors will determine whether the resin will be fusible or infusible, hard or soft, soluble or insoluble, transparent or opaque.

Alkyd resins rank high in their application to lacquers, varnishes and paints. Several of these synthetics are prepared especially for use and blending with nitrocellulose. Lacquers so prepared are very durable and have excellent gloss.[2] Other alkyd resins are prepared for use with varnishes and paints to give them superior drying qualities, and a tough, hard film which is free of tackiness and poor setting.[3] It has been shown that the addition of alkyd resins to paints decreases the quantity of drying oils needed.[4] A series of tests made in 1931 show the superiority of alkyd-containing quick-drying house paints.[5]

Modified glyceryl-phthalate resins known as "Rezyls" are used almost exclusively with nitrocellulose lacquers, especially for those used on automobiles. These are prepared in three main classes (a) lacquer type or saturated Rezyl or Rezyl balsams, (b) oxidizing type of unsaturated Rezyls, (c) Teglacs, Rezyls modified with natural resin acids. These are used as lacquers per se, as sealers and as sander coaters, respectively.[6]

L. E. Barrington[7] has pointed out an application for alkyd resins in the foundry. The foundry core must possess certain properties, among which are—(a) ready workability, (b) mechanical strength, (c) permeability, (d) smoothness of surface, (e) heating resistance and (f) disintegration or collapsibility after casting is poured. Alkyd resins appear to possess all of these desirable properties. These resins are also used in special cases as bonding agents for such fillers as mica, asbestos, and abrasives, when converted to the heat hardened stage in hydraulic presses. These molded materials possess marked heat resistance, toughness, and electrical insulating properties.

One British patent[8] summarizes many of the possible applications of the alkyd resins. These products may be blended with cellulose derivatives and ester gums, synthetic resins and synthetic resin forming materials, bituminous, natural or synthetic waxes, pigments, plasticizers, fillers, lakes, etc., for use in the manufacture of coating compounds, molding plastics, impregnating agents for paper, wood, etc., adhesives for safety glass, linoleum, cements, sealing wax, insulating materials and the like.

The reaction of glycerol with many other materials to form resins useful for a variety of purposes has been the subject of a large number of patents. When glycerol is heated to about 230 deg. C. with a carbohydrate-phenol resin, a product is obtained which is claimed to be suitable for molding and for use in varnishes.[9] According to another patent, a carbohydrate, such as dextrose, heated with glycerol in the presence of a condensing agent such as sulphuric acid produces a moldable material.[10] A product resulting from the condensation of glycerol with adipic or sebacic acid[11] shows some very interesting characteristics. The material so prepared is of a soft rubbery nature suitable for use with nitrocellulose or other cellulose esters, forming compounds of good flexibility, elasticity and toughness. On solidification these are insoluble in the common solvents.

Glycerol in the presence of a catalyst can also be resinified by direct polymerization.[12] The most efficient catalysts of this direct polymerization of glycerol are sulphuric and sulphurous acids sulphates and sulphites particularly mercurous and (*Continued on page 73*)

LIGNIN AND LIGNIN PLASTICS (A REVIEW)

by GORDON M. KLINE

Continued from page fifty-one, April issue

Woods waste in Douglas fir logging

Table 4. - Impact strengths of various lignin-cresol resins made from lignite:

Sample	Impact strength cm kg/sq cm
Lignite with 4.0 percent cresol	4.2
" " 6.0 " "	5.0
" " 8.0 " "	4.9
" " 10.0 " "	4.4
" " 12.5 " "	7.9
" " 15.0 " "	6.1
" " 17.5 " "	5.1
Phenol-formaldehyde resin	5.2

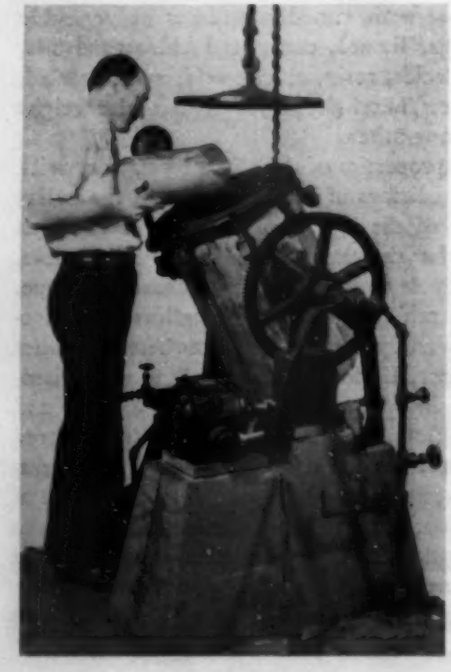
Reaction of lignin with phenols

It has been known for many years that phenols will dissolve lignin at a temperature of about 200° C (16). This solvent action of phenol is the result of its condensation with lignin. The reaction is accelerated by the presence of small amounts of mineral acids. Separation of the lignin from cellulose can be effected in 4 to 5 hours at 100° C by the addition to the phenol of 0.1 percent of sulphuric acid or at 80° C with 1 percent of acid (17). Legeler observed that on treating 100 kilograms of dry wood with phenol, 36 kilograms of phenol remained condensed with the noncellulosic constituents, 45 kilograms of pure cellulose being obtained.

Fischer (18) and his colleagues have made detailed experiments on the production of resins from lignin derived from coal. They found that the brown coal lignites, which they analyzed by hydrolysis with 72 percent sulphuric acid, contained 66.4 to 92.8 percent of lignin, calculated on the basis of dry (105° C) ash-free material. The solid lignin-containing material is ground and dried by heating in a vacuum oven. Cresol is added to the dried powder and the mixture is kneaded in the presence of a low-boiling solvent for several hours at 80° C. Under these conditions a remarkable swelling takes place, the material gradually reaching about double the original volume. When the swelling ceases, the solvent is removed by distillation under reduced pressure. The residue can be molded at 350 kg/sq cm (4979 lbs/sq in.) pressure and 150° C. The effect of varying the cresol percentage on the impact strength of the molded test bars is shown in table 4. It is seen that the lignite-cresol products reach a strength of more than 5 cm kg/sq cm, which the author cites as the minimum strength required for the phenol-formaldehyde resins. The phenol-formaldehyde product for which the impact strength is cited in table 4 was a specially prepared sample. An increase in pressure above 300 kg/sq cm (4266 lbs/sq in.) results in an impact strength reaching the optimum at about 900 kg/sq cm (12,798 lbs/sq in.) after which the strength of the pressed material decreases. The author says the lignin-cresol resin does not melt and go to an insoluble, infusible state like the thermosetting phenol-formaldehyde resins.

In an investigation of the utilization of corncobs and oathulls for the production of plastic materials, Harris (19) found that cellulose, pentosans, pentoses and lignins condense with phenol in the presence of sulphuric acid,

Charging a digester at the Forest Products Laboratory



hydrochloric acid or zinc chloride as catalysts. In the reactions the ratio of phenol to cellulose, etc., was varied from 1:2 to 3:2 and the ratio of phenol to catalyst was maintained at 5:1. The experiments were conducted at temperatures ranging from 90° to 160° C. The product in each case was a black, tarry material which could be made into a rather brittle, black resin by removal of volatile constituents.

The following process was developed for producing a plastic material directly from the corncobs or oathulls. Five parts by weight of zinc chloride or sulphuric acid are dissolved in an equal weight of water and then combined with 100 parts of cresol or phenol. The mixture is heated to boiling in an autoclave. Thirty parts of ground corncobs or oathulls are gradually introduced with stirring into the hot cresol mixture. The autoclave is closed and the temperature kept at 140° C for 3 hours. The pressure is then released and the reacted material is subjected to a vacuum distillation until the boiling point rises to 260–300° C, depending upon the desired melting point of the resin. The resin is run out into flat pans, cooled until solid, and ground to a powder. The molding compound is prepared by grinding together 40 parts of the powdered resin and 60 parts of wood flour. The optimum molding temperature was found to be approximately 140° C. The use of 2 percent of zinc stearate or stearic acid gives additional plasticity, but this advantage is offset by the greasy appearance of the molded product. The addition of hexamethylenetetramine reduced sticking in the mold and increased the strength of a molded disk so that it withstood the impact of a 2-kilogram weight dropping 26 centimeters (Page impact testing machine), whereas the untreated disk withstood a drop of only 11 centimeters.

Many other waste materials which contain lignin have been proposed for the production of plastic products, by reaction with phenols. Thus L. R. Jones (20) utilizes peanut hulls, cottonseed hulls, and other cellulosic materials. One part of these substances is heated with less than one part of a phenol in the presence of an inorganic acid such as hydrochloric acid until a sticky, gummy, fusible, partially disintegrated mass is produced. The acidic substances may be removed by washing or may be neutralized with an alkaline earth metal salt such as barium carbonate. The addition of an aldehyde hardening agent is reported to yield an improved product. Chulkov and his collaborators (21) treated free lignin or the lignin-containing substance with 10 parts of phenol in the presence of about 0.1 percent hydrochloric acid at 180° for 2.5 hours. The product is washed free from phenol and extracted with ethyl alcohol. Lignin-phenol resin is precipitated from the extract with water. It contains free hydroxyl groups which can be methylated.

Reaction of lignin with amines

The preparation of synthetic resins from lignin by condensation with aromatic amines has been studied by Phillips and Weihe (22) and also by Fischer, Horn and Kuster (18). The latter reported that the resins they obtained by the reaction of lignin with aniline, naphthylamine, pyridine, piperidine and quinoline were similar to those of the cresol-lignin type previously described. Phillips and Weihe used lignin isolated from corncobs by the alkali method. The corncobs were treated with six times their weight of 2 percent sodium hydroxide solution and heated in an auto- (*Continued on page 74*)

Table 5. - Condensation of lignin with aromatic amines

Aromatic amine	Optimum ratio lignin: 2nd component (parts by weight)	Optimum temperature °C
Aniline	2:1	160
p-Toluidine	2:1	170
p-Toluidine	3:2	-
Cymidine*	1:1	150
p-Nitraniline	1:1	150
p-Nitraniline	1:1	160
Dimethylaniline	2:1	170
"	3:2	160
p-Tolylenediamine	1:1	150
Benzidine	1:1	200
Tolidine	1:2	170
α-Naphthylamine	2:1	150
β- "	1:1	150

*One part of concentrated hydrochloric acid added.

Table 6. - Condensation of lignin with furfural

Catalyst	Parts by weight of Lignin	Furfural	Catalyst	Optimum time of heating	Optimum temperature °C
Conc. hydrochloric acid	3	5	1	1	80
Sodium carbonate	10	5	0.5	1	150 (sealed tube)
Pyridine	10	5	1	1	150 (sealed tube)
Calcium oxide	10	5	1	2	150 (sealed tube)

U. S. plastics patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C. at 10 cents each.

TRANSPARENT FLEXIBLE FILM. D. W. Hansen (to Prolamine Products Inc.). U. S. 2,074,332, Mar. 23. Transparent wrapping material comprising a fixed prolamine, dibutyl phthalate as a plasticizer, and a transparentizing quantity of triethanolamine.

CELLULOSIC PELLICLES AND METHOD FOR PREPARING SAME. F. C. King (to E. I. du Pont de Nemours and Co.). U. S. 2,074,336, Mar. 23. Transparent, flexible pellicle coagulated from an aqueous alkaline cellulosic dispersion and softened with a solid water-soluble amide and a glycol. See also U. S. 2,074,349, Mar. 23.

PROCESS FOR THE MANUFACTURE OF ARTIFICIAL RESINS. H. Honel (to Beck, Koller, and Co.). U. S. 2,074,509, Mar. 23. Phthalic anhydride, glycerine and castor oil are heated at 260–270° C. until a reaction product soluble in benzene hydrocarbons and with drying capacity is obtained.

MANUFACTURE OF FOILS AND ARTIFICIAL PRODUCTS. M. Hagedorn and A. Ossenbrunner (to Agfa Ansco Corp.). U. S. 2,074,647, Mar. 23. Film adhesive layer containing antistatic material such as an alkali metal salt of a polymeric carboxylic acid.

RESINOUS COMPOSITIONS AND PROCESS OF MAKING SAME. D. E. Edgar (to E. I. du Pont de Nemours and Co.). U. S. 2,074,782, Mar. 23. A polyhydric alcohol-polybasic acid resin modified with fatty oil is heated with an organic peroxide and the product combined with a urea-aldehyde condensation product.

SYNTHETIC RESIN. G. Graves (to E. I. du Pont de Nemours and Co.). U. S. 2,074,786, Mar. 23. Reaction product of an aldehyde and a polynuclear polyketone, the carbonyl carbons being part of hydroaromatic rings and attached to at least one methylene group.

RESINOUS COMPOSITIONS AND PROCESS. W. W. Smith (to E. I. du Pont de Nemours and Co.). U. S. 2,074,814, Mar. 23. A polyhydric alcohol-polybasic resin modified with fatty oil acids is combined with urea-aldehyde product.

CONTAINER CLOSURE. B. F. Conner (to Colt's Patent Fire Arms Mfg. Co.). U. S. 2,074,830, Mar. 23. Specification for a molded closure.

THERMOPLASTIC. Geo. J. Manson. U. S. 2,075,045, Mar. 30. Making a thermoplastic material by compounding polyvinyl acetate with a substantial proportion of sulphur.

RUBBER HYDROCHLORIDE. H. A. Winkelmann (to Marbon Corp.). U. S. 2,075,251-2 and 2,075,254, Mar. 30. Fluxing rubber hydrochloride with sulphur, or milling rubber with chloroprene and treating with hydrogen chloride, or forming rubber hydrochloride and heating it with sulphur until a reaction occurs.

RUBBER DERIVATIVE COMPOSITION. H. A. Winkelmann and E. W. Moffett (to Marbon Corp.). U. S. 2,075,253, Mar. 30. Making a hydrochloride by the action of liquid hydrogen chloride on vulcanized rubber, and compounding the product with a chloroprene polymer.

RUBBER HYDROCHLORIDE FOILS. E. Gebauer-Fuelnegg and E. W. Moffett (to Marbon Corp.). U. S. 2,075,255, Mar. 30. Making transparent foils by casting a solution of a synthetic rubber hydrochloride on a forming belt.

MOLDING COMPOSITION. Carleton Ellis (to Ellis-Foster Co.). U. S. 2,075,276, Mar. 30. A urea-aldehyde resin composition containing added protein.

SMOKING PIPE. Preston M. Hall. U. S. 2,075,281, Mar. 30. A pipe bowl is formed of a compressed mixture of dried tobacco and a synthetic resin.

WATERPROOFING. G. A. Albert (to National Vulcanized Fiber Co.). U. S. 2,075,328, Mar. 30. Waterproofing a cellulosic material without sacrificing its other properties by immersing in a solution of an intermediate synthetic resin product, then converting the resin to its final stage.

CONDENSATION PRODUCTS. L. Cserny (to Resinous Products and Chemical Co.). U. S. 2,075,340, Mar. 30. Obtaining color effects in molded articles by slicing blocks of amide-phenol-formaldehyde resins which differ in color, superimposing the slices, joining the slices under pressure at 50–100° C., and heating at the same temperature until the resin formation is completed.

SYNTHETIC RESINS. G. D. Graves (to E. I. du Pont de Nemours and Co.). U. S. 2,075,343, Mar. 30. Making new resins by reaction of a polyether resin with an organic polyhalide having the halogens attached to different carbon atoms which are in turn attached to an ether oxygen atom.

LACQUER RESIN. R. T. Ubben (to E. I. du Pont de Nemours and Co.). U. S. 2,075,376, Mar. 30. A resin which is at least equal to natural resins for imparting durability and color fastness to nitrocellulose lacquers is made by condensing formaldehyde with a phenol having a tertiary alkyl substituent para to each phenolic hydroxy group, and neither more nor less than 2 unsubstituted positions ortho to a phenolic hydroxy group.

VINYL RESINS. S. D. Douglas (to Union Carbide and Carbon Corp.). U. S. 2,075,429, Mar. 30. Catalytic interpolymerization of vinyl chloride with a vinyl ester of an aliphatic acid in a liquid which is not a solvent for the polymer, which is thus removed from the system as rapidly as it is formed. See also U. S. 2,075,575, Mar. 30.

STABILIZING VINYL RESINS. M. C. Reed and Frazier Groff (to Union Carbide and Carbon Corp.). U. S. 2,075,543, Mar. 30. Stabilizing a vinyl resin (interpolymerized vinyl chloride and vinyl ester) by adding a small proportion of a cadmium, lead, manganese or alkaline earth soap.

SAFETY GLASS Jas. H. Sherts (to Pittsburgh Plate Glass Co.). U. S. 2,075,667, Mar. 30. An improved method for casting a plasticized synthetic resin interlayer for safety glass.

WHITE MOLDED ARTICLES. Carleton Ellis (to Ellis-Foster Co.). U. S. 2,075,804, April 6. Using an acid condensation product of urea and formaldehyde in white molded shapes.

UREA RESIN PLASTICS. Carleton Ellis (to Ellis-Foster Co.). U. S. 2,075,805, April 6. Impregnating wood flour with a neutral urea-formaldehyde condensation product containing added magnesium carbonate, drying, grinding, adding about 1% of a solvent such as glycerol dichlorohydrin and hot pressing to form molded articles with good resistance to hot water.

VARNISH. V. H. Turkington (to Bakelite Corp.). U. S. 2,075,839, April 6. An oil varnish containing an oil-soluble synthetic resin plasticized with a neutral aryl ester of a dicarboxylic acid. See also U. S. 2,076,507, April 6 (phenol-aldehyde-fatty oil resin).

INSULATING MATERIAL. Alfred Curs and Hans Wolf (to Plaskon Co., Inc.). U. S. 2,076,295, April 6. Beating a solution of urea-aldehyde resin to a froth, mixing with an acidic foam, and hardening the foam to produce cellular insulation.

LAMINATED MATERIAL. A. Gams. K. Frey and T. Sutter (to Society of Chemical Industry in Basle). U. S. 2,076,456, April 6. Laminated rolled articles are made by coating a sheet material with a fusible nonhardening aniline-formaldehyde resin and uniting successive coated layers under heat and pressure.

ABRASIVE ARTICLES. N. P. Robie (to Carborundum Co.). U. S. 2,076,517, April 6. A heat hardenable molding composition for making abrasive shapes contains abrasive (*Continued on page 60*)

The Age of Invention

David Hutchison has recently completed the last of three murals for the children's room of the Yonkers, N. Y., Public Library. This new mural, called "The Age of Invention," shows a panoramic view of Yonkers looking out over the city toward the Hudson River and Palisades, New Jersey. The figures portrayed are all eminent men who have contributed to invention and science, including five Yonkers scientists: Dr. Leo H. Baekeland, inventor of Bakelite resinoid; Rudolf Eickemeyer, inventor of the trolley motor; Charles Proteus Steinmetz, electrical wizard; Halcyon Skinner, inventor of the Axminster loom; Dr. Michael Pupin, research scientist. Doctor Baekeland is seated on the right near the center observing his chemical apparatus. In the background his first commercial still unit is illustrated. Other noted figures easily recognized are Thomas A. Edison, the Wright Brothers, Robert Fulton, Alexander Graham Bell, Henry Ford, Charles A. Lindbergh and George Eastman.

Plastics Society to organize

The first "get-together" this year of the Plastics Industry will be at Buckwood Inn, Shawnee-On-Delaware, Penna., on May 24-25. As usual, the meeting will consist primarily of golf, but those present will witness the organization meeting of the *SOCIETY OF THE PLASTICS INDUSTRY* which was initiated last fall at Lenox, Mass., by certain prominent "Charter Members" of the industry. The purpose of this Society is to have established an organization responsible for holding these get-together meetings, and it is hoped that sufficient interest will develop to enable the Society eventually to take on more serious activities than socializing and golf.

While golf is mentioned as the principal activity of the current meeting, there will be other diversions, depending upon the interest of those present, such as horseback riding, tennis, fishing, trapshooting (Yes, that first letter is "T"), archery and swimming. Facilities for all these sports are available right around Buckwood Inn grounds.

Reservations already received indicate that the largest number of plasticians ever brought together will be assembled on those two days. If you haven't sent in your reservation, better get it off today. Mail it to Gordon Brown, the Bakelite Corporation, 247 Park Avenue, New York City. It might be added that most of those reservations sent have been accompanied by a check for one dollar as a voluntary contribution towards prizes.

These meetings in the past, although purely social, have resulted in immeasurable benefits to those present. Those who remain away, with the notion that such junkets are beyond their ken, would be amazed at the spirit of friendliness and cooperation which these meetings have sponsored throughout the industry. To share in these benefits, you, too, must be there.

Off to Europe

Svend Hansen of the Marblette Corporation is sailing in June on the S S Kungsholm for a three month European trip during which he will visit England, Germany, France, Austria and Italy investigating new materials and developments in the plastics field.

Tenite names Coast representative

Tennessee Eastman Corporation recently appointed Wilson & Geo. Meyer & Company as Tenite sales representative in the states of California, Washington, Oregon and British Columbia. This organization has had previous experience with the marketing of a molding composition and maintains offices at Federal Reserve Bank Bldg., San Francisco; 2461 Hunter Street, Los Angeles; and 710 Belmont Place, Seattle.

Monsanto advances Ed. Schuler

Ed. Schuler, assistant manager of the New York Office of Monsanto Chemical Company, has been made manager of the company's Pacific Coast District Office at San Francisco where he will have charge of the sale of products made by Monsanto and its affiliated companies, succeeding Charles L. Fetzner. Mr. Fetzner who has been at San Francisco for the past several years will undertake important duties at the main office in St. Louis.

Richland now vice-president

J. Frank, president of Gemloid Corporation, recently announced the appointment of Philip Richland as vice-president and general sales manager of the company.

Detroit representative appointed

The Synthane Corporation, manufacturers of laminated phenolic, announce the appointment of Mr. William H. Borden as their Detroit representative. Mr. Borden, until his appointment, represented the company in Pittsburgh. His offices in Detroit are located at 7310 Woodward Avenue.

NEWS and NOTES

Shock resistant plastic developed

A phenolic molding material with five times greater impact strength than standard molding materials has just been announced by General Plastics Inc. Known as Durez 1590, the material has an impact strength of .7 (A.S.T.M.) and should find many industrial applications where greater resistance to shock is desired, along with the other well-known properties of molded plastics. It molds and preforms easily, has a relatively low bulk factor and in molded form has a somewhat rippled surface, which can be minimized by ribbing or engraving in the mold on decorative pieces.

G. E. opens Electrical Products exhibit

An exhibit of electrical products for industry has been opened in the General Electric Building, 570 Lexington Avenue, New York City. It brings together in 7000 square feet of floor space, a complete line of representative products of General Electric and its affiliates. Molded and laminated plastics are shown in their many capacities and it is rather amazing to discover in just how many places in industrial equipment these versatile materials appear.

Plastics reduce freight costs

Factual data on the saving in freight made possible by redesigning in plastics are revealed in figures for the calendar year 1936 on shipments of Toledo Plaskon scales. Although this scale is but one model in an extensive line, and although the company's general business showed an increase, the total item of packing and freight on all models was less in 1936 than in 1935. The saving is directly due to the Plaskon model.

Average freight charges on an equivalent model with metal housing were $3.09. Average freight charges on the Plaskon scale were $1.31. Average boxing and packing costs of the old type were $2.92, on the Plaskon scale, $1.44. Average weight of the old scale, packed, was 196 pounds, of the Plaskon scale 77 pounds.

"It is astonishing that this change of just one model in our line could make such a big difference," comments H. D. Bennett, president of the scale company. "Furthermore, it throws light on future engineering policy. It is obvious that there are interesting possibilities in this method of offsetting increased costs due to such other items as taxes, materials, etc."

A.S.T.M. annual meeting

During the week of June 28–July 2, the 1937 (Fortieth) Annual Meeting of the American Society for Testing Materials will be held at The Waldorf-Astoria, New York City. Throughout the week there will also be in progress the Fourth Exhibit of Testing Apparatus and Related Equipment. This will be the second meeting which the A.S.T.M. has held in New York City, the previous one having been there in 1912 during an international congress on testing materials.

Toilet goods association convention

Please be advised that the annual convention of the Toilet Goods Association will take place on Tuesday, Wednesday and Thursday, May 25, 26 and 27 at the Biltmore Hotel in New York City.

Alphide, a new material

Standard Plastics Corporation announce a new self-heating plastic material, called Alphide, which requires no elaborate dies or high pressures to mold. Fabrication of the material will be confined to their own plant and it is claimed to offer savings of 30 to 40 percent for applications suitable to its use. It may be drilled, sawed, or turned like cast resins and can be molded in any shape with tool charges reported to be low. The material is said to have good dielectric properties but is not recommended where precision is of paramount importance. We expect to present the story of Alphide in greater detail in an early issue.

N. Y. World's Fair signs first exhibit contract

The march of industrial America to the New York World's Fair of 1939 got under way recently with the far-flung American Telephone & Telegraph Company in the van. Walter S. Gifford, president of A. T. & T., and Grover Whalen, president of the Fair, signed a contract paving the way for erection by the corporation of a building and exhibit to constitute one of the principal features of the Fair. The agreement is the first exhibit contract which the Fair Corporation has entered into. Numerous others are in the final stages of negotiation, according to Mr. Whalen, who predicted that within a few weeks all of the seventy-five acres of building lots will have been allocated to exhibitors.

"The Fair is being enthusiastically received by business and industry," he said. "Every corporation which we have approached has been sold from the start on the idea of participating. They like our theme. They like our new way of grouping exhibits. They are anxious to cooperate in every possible way. It looks now as if the sale of exhibit space would exceed our highest hopes."

Coldspot electric refrigerator parts injection-molded of **TENITE** by Hoosier Lamp and Stamping Corporation for Sears, Roebuck and Company

TENITE ON THE 1937 COLDSPOT . . . insulating strips and hand grips, shelf supports, lugs, and handles with chromium trim, molded by the rapid injection process. The low heat conductivity, exceptionally high shock resistance, and smooth lustrous mold finish of Tenite make it the ideal plastic for this exacting application. An illustrated 52-page book describing the injection and compression molding characteristics of Tenite and its adaptability for many industrial and decorative uses will be sent you on request.

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ADVERTISING PAGES REMOVED

BOOKS and BULLETINS

Booklets reviewed in these columns will be sent without charge to executives who write for them on their company letterheads. Other books will be sent postpaid at the publishers' advertised prices

The Locomotive

by Raymond Loewy
Published by The Studio, Ltd. London & New York
Price $2.50

Raymond Loewy, the author of this book, is the artist-designer who was responsible for streamlining the two types of Locomotive which the Pennsylvania Railroad has adopted. Using pictures as words he shows in this work the glorious adventure of the artist-engineers who are revolutionizing the appearance and performance of transportation equipment throughout the world.

Locomotives are represented from America, Austria, France, Germany, Great Britain, the Netherlands, Norway, Soviet Russia and the Far East. Beginning with Trevithicks Portable Steam Engine (1808) Mr. Loewy takes the reader on a pleasant pictorial journey through the adventures and mis-adventures of transportation development from that day to this. Poignant paragraphs point to the merits and fallacies of these international efforts to reach perfection.

Whippet fans will be interested in the "Caniposte" Railway (L'Illustration, 1845) which was used in Belgium for fast mail transportation. A stuffed hare is fastened at the end of a rod in front of two hungry dogs which pull the car. An improved model, it is reported, used a chunk of fresh meat.

From such oddities, Mr. Loewy continues through the evolution, discussing briefly the Diesel-Electric plant, Electric Engines, Wind-tunnels, the Steam Engine in its various capacities, Design and Speed, with comments and illustrations pertinent to the more recent examples both here and abroad. A good photographic history, but a bit disappointing in commentarial details. (E. F. L.)

A. B. C. of Plasticisers

Chemical Publ. Co. of N. Y. C., sole agents No. and So. America
Published in England. Price $1.25

For the first time there is presented a comprehensive, authoritative survey of plasticisers and flexibilizers for lacquers and plastics in this 80-page paper bound book. It is interesting because some plasticisers are useful with one compound and useless with another. Chemical and physical properties of well known and comparatively lesser-known plasticisers are given and the range covers British, continental and American products.

The Chemistry of Natural Products Related to Phenanthrene

by L. F. Fieser
Published by Reinhold Publ. Corp. Price $7.00

The second edition of this Monograph was published in order to keep pace with the rapid advances in phenanthrene chemistry, and a survey of recent literature has been included in the form of an appendix.

The book contains 476 pages and is profusely illustrated with formulas, engravings, complete references to original literature, and extensive author and subject indexes. A reprint of the 91-page appendix, with revised indexes, will be supplied separately to the purchasers of the First Edition at $1.00.

Seven chapters deal with the chemistry of phenanthrene, resin acids, cancer-producing hydrocarbons, sterols and bile acids, sex hormones, heart poisons, and saponins. Complete references to recent papers bear publication dates up to January 1, 1937. (J. M.)

What is the cost?

"Probably the commonest question asked daily in America, or throughout the world for that matter, is 'What is the cost?'" says Lamont du Pont, president of E. I. du Pont de Nemours, Inc., in an article in the current issue of *Monsanto Current Events*. "Obviously, the chemist **must** give more for less, when he submits to industry the results of his research, or practical men will merely laugh at his efforts. We don't adopt new materials or new methods at the cost of scrapping old ones, simply because they are new. The new must be better than the old to justify itself in competition." Cost, however, is a relative thing and Mr. du Pont taking Neoprene as an example, points out that its price at this time is three times that of natural rubber, yet on the basis of utility, the synthetic product actually is cheaper than rubber for numerous uses because it will outlast the natural product five times or more.

This question of cost is frequently a determining factor in the choice of all plastic materials. Mold costs cannot be ignored, nor straddled. They represent an incidental and legitimate item by which the multitude of advantages of these materials may be enjoyed in modern manufacture. The question "What is the cost" must be measured, and answered, by the service the finished product will give in a definite comparison with other fundamental materials.

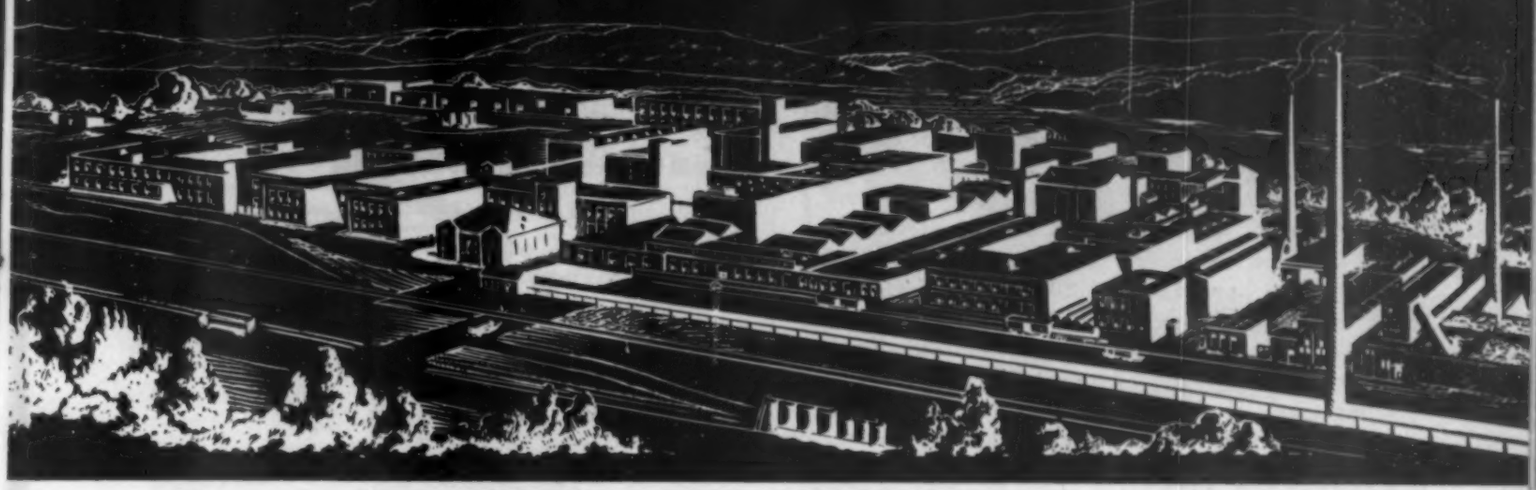
Stokes preforming press

A new folder entitled "Stokes-Standard Press" is ready for distribution. The folder describes, concisely, this preforming press which is capable of exerting up to 80 tons pressure and of making a 4-inch preform. It also contains a number of installation views and other illustrations. Specifications are incorporated on each of three models. Shown also are other Stokes preforming machines and some typical products compressed on them.

R & H Chemical Price List

The April 1937 issue of the Quarterly Price List, issued by R & H Chemical division of E. I. du Pont de Nemours & Co. Inc. is now ready for distribution.

Serving ALL INDUSTRY



Plastics for every use are made here

Over a half century devoted exclusively to the manufacture of thermoplastics and cast phenolic resins has given The Fiberloid Corporation an understanding of the problems which confront modern industry. Their engineering and developing facilities are at your command.

The various materials manufactured are furnished in sheets - rods - tubes - special shapes - liquids - moulding slabs, granulations and powders.

FIBERLOID — Pyroxylin Plastic

FIBESTOS — Cellulose Acetate Plastic

FIBERLON — Cast Phenolic Resin

FIBERLAC — Cellulose Cements and Lacquers

THE FIBERLOID CORPORATION

INDIAN ORCHARD, MASS.

New York: Lincoln Bldg. **Chicago: Daily News Bldg.**

BOOKS and BULLETINS

Scientific glass apparatus

A comprehensive catalog of interchangeable glassware for chemical-biological physical laboratory apparatus has been published by Scientific Glass Apparatus Co. It outlines the ability of the company to work with engineers and inventors on any type of glass apparatus and in any scientific field. A staff of glass-blowers, grinders, and engravers is maintained to execute difficult individual commissions.

Glyptal printing rollers

(From General Electric Review, January 1937)

Rubber rollers used in the printing industry generally swell and become irregular in shape after being exposed to printer's ink for a relatively short time. Reconditioning the surface adds but little more to the life of the rollers. Glyptal is now being used by roller manufacturers for printing rollers that will maintain a constant degree of softness and not lose shape during a year or more of constant use.

In the early development of Glyptal resin, only hard rollers could be produced. Gradually, as information about the nature of the material came to light, softer and softer rollers were made until, at present, Glyptal can be prepared with any degree of flexibility from celluloid-like rigidity to extreme flaccidity. Rollers of this new type are oil-resistant and therefore do not swell with printing inks. Furthermore they do not melt nor become excessively soft during the heat of long summer runs as do ordinary glue-glycerin rollers.

At the present time, most of the output of the flexible resin goes into printing rollers of some sort, but Glyptal is also used for printers' blankets and type plates for printing on uneven surfaces. Ordinary Glyptal is obtained from a reaction between polyhydric alcohols and polybasic acids. Flexible resin is made by internally plasticizing Glyptal with glycol adipate. G. M. K.

Odorless, water-white plasticizer

The Neville Company recently introduced an odorless. water-white plasticizing oil, called Nevillite Oil, which, it is claimed, will prove useful for varying industrial purposes. It is neither a hydrocarbon resin solution, nor a soft resin, but a separate treated polymer having a viscous liquid consistency. It is not an ester nor does it have any ester content. Nevillite Oil is reported to be a stable plasticizer for most natural and synthetic gums and resins, and dissolves them or mixes homogeneously with their solutions.

This new product is a high-solvent strength, non-volatile solvent and plasticizer for chlorinated rubber coatings, pyroxylin lacquers, plastic compounds, printing inks, waterproofing compositions and so forth. Its specifications and properties are set forth in a folder which is available to those interested.

SHOP EQUIPMENT

New size 00 A-C contactor

A new size oo A-C multiple magnetic contactor (Type CR2810) has been developed by General Electric for controlling small single-phase and polyphase motors, or for use as a flexible relaying device for comprehensive control systems such as are used on machine tools. The contactor is compact and easy to install.

Patent rotary cutter

Ball and Jewell announce a newly improved rotary cutter with outboard roller or ball bearings and positive end seals. It is reported that this end seal successfully excludes water from the bearings when water is used in cutting inflammable materials. Likewise, it prevents oil from the bearings entering the cutting chamber when used in dry cutting. Cutters are of stainless steel and changing from one colored material to another is an easy matter. Illustrated folder has been recently issued.

Hammond vari-speed polishing and buffing lathe

Type RV "Vari-Speed" 3 to 7½ horse power

The Hammond Machinery Builders, Inc., announce a new variable speed polishing and buffing lathe which, it is stated, is specially adapted to plastic polishing and buffing requirements.

According to the makers, the new Hammond "Vari-Speed" gives unlimited range of speed between low and high speed. In other words, any speed within a 50 percent increase of the low speed can be obtained by simply expanding or contracting the variable speed pulley to Vernier scale letter and corresponding speed figures on speed chart located directly in front of operator: Examples—2000 to 3000 R.P.M., 1800 to 2700 R.P.M., etc.

Speed can be increased or decreased twenty-five revolutions at a time if desired. Greater range can be had by changing pulley on motor. Standard machines are equipped with a solid sheave on motor with a variable speed pulley on spindle.

Peter Koch de Gooreynd, Anglo-Belgian inventor and industrialist of London, showing a trayful of the new transparent plastic lenses which appear to have revolutionized optical lens-making. An all molded sports binocular in which these lenses are used is on display at MODERN PLASTICS PERMANENT EXHIBIT

PLASTIC OPTICAL LENSES

By W. Hamilton Gordon, London, England

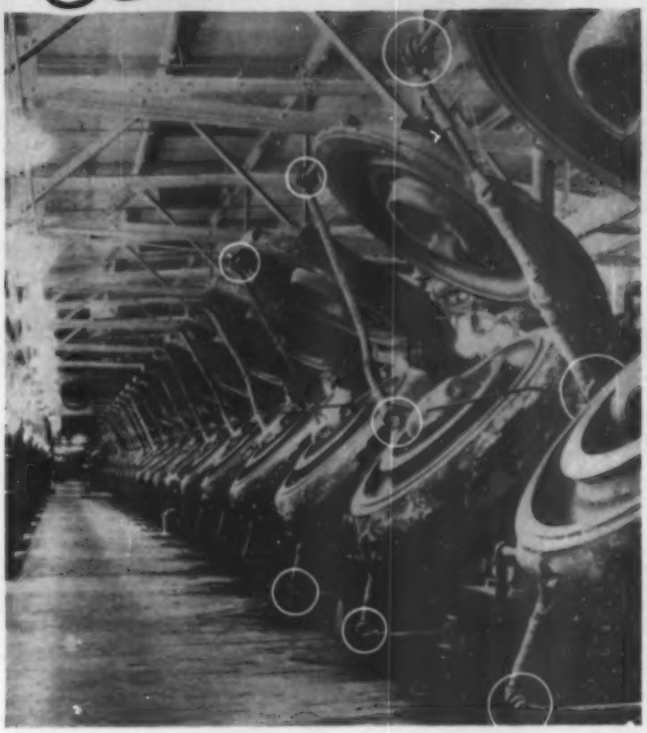
An entirely new method is being used for the production of optical systems—lenses and the like—from plastic materials, a method developed by two British inventors, Arthur W. Kingston and Peter Koch de Gooreynd, which seems likely to exercise a revolutionary influence on the whole optical industry.

The invention is a molding process, delivering from specially designed machines, lenses already polished and ready for mounting in cameras, binoculars, opera glasses, telescopes, spectacles, range-finders, stereoscopes, scientific instruments, television apparatus, and so on. The lenses are made by special treatment for their particular purposes from various plastic and transparent materials. They are for all practical purposes unbreakable, as well as being half the weight of glass and having certain optical properties which are claimed to make them superior to glass. One of the plastics used in the process is "Perspex," which was recently developed by Imperial Chemical Industries, Ltd.

The invention obviates all the long and expensive grinding and polishing processes in the hands of highly skilled labor which are at present necessary for the manufacture of optical systems. Yet, experts in the many fields of optical research have passed the new type of lens as being of very high optical quality. It is even thought that the lenses will lend themselves to many novel uses which may have far-reaching results in the more highly scientific side of optics, and in laboratory work.

The British optical glass industry, though highly efficient, is small, the bulk manufacture of lenses being in the hands of foreign countries. The invention therefore presents a real opportunity to build up a British industry which will, by eliminating the larger part of the present import, employ indirectly a large mass of domestic labor. *(Continued on next page)*

CONVINCING!



Leading Rubber Manufacturers

USE BARCO SWIVEL JOINTS

To Insure Leakproof Service and Cut Production Costs

Swivel 7AS2BS

Swivel 78-8CS

There are reasons why BARCO Swivel Joints are used on the battery of molds shown above. BARCO Swivel Joints are used by leading rubber manufacturers on molds, platen presses, vulcanizing and other machines. On any equipment requiring swivel movement, BARCO Joints speed up production, eliminate lost time, give trouble-free service and save money by uninterrupted performance.

Providing full 360° swivel movement without binding, they do not leak with alternating heat and cold. Fluid-tight under suction or pressure. Gaskets cannot blow out. For more information request a copy of Catalog 256.

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1813 Winnemac Avenue, Chicago, Ill.

The most modern molding press will be inefficient

UNLESS . . .

A COLTON PREFORMING

machine backs it up!

Colton Preforming Machines are the accepted standard in the plastics industry not only because they speed up the molding cycle but because their unvaring accuracy of performance is a guarantee of better molding at the press. When Colton preform-pellets are used material waste is eliminated, flash is held to the ideal minimum, material handling problems are simplified and costs d
r
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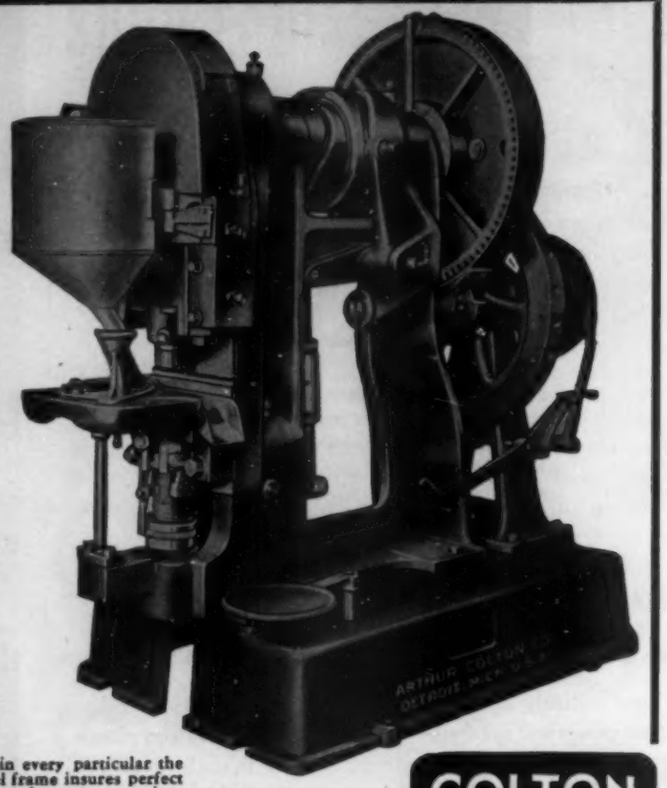
p

Write us for full details about our complete line of single punch, multiple and rotary preforming machines.

ARTHUR COLTON CO.

2604 E. JEFFERSON AVENUE

DETROIT, MICHIGAN



The new improved 5½ tablet machine—in every particular the finest the market has to offer. Solid steel frame insures perfect operation; improved die fastners, improved cam construction, heavier ejecting mechanism, vanadium steel plungers—make high speeds possible without fear of breakdown or lowered quality. Makes tablets up to 3" in dia. having a fill depth up to 2½".

COLTON DETROIT

PHENOL
SANTICIZERS (PLASTICIZERS)
SANTOLITES (SYNTHETIC RESINS)
COTTON SOLUTIONS
DIBUTYL PHTHALATE
DIETHYL PHTHALATE
DIPHENYL PHTHALATE
DIMETHYL PHTHALATE
TRICRESYL PHOSPHATE
TRIPHENYL PHOSPHATE
PHTHALYL GLYCOLLATES

Monsanto Chemicals

for the **PLASTIC, RESIN AND OTHER INDUSTRIES** have proved their ability to produce consistently superior and economical results.

Manufactured by

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CHARLOTTE CLEVELAND SAN FRANCISCO MONTREAL

AMYL ACETATE
BUTYL ACETATE
ETHYL ACETATE
AROCLORS (CHLORINATED DIPHENYL)
MALEIC ACID
MALEIC ANHYDRIDE
PHTHALIC ANHYDRIDE
DIACETONE ALCOHOL
MERSOL (SOLVENT ALCOHOL)
ORTHODICHLORBENZENE

CHEMICALS OF QUALITY

Monsanto

The advantages of the invention in particular fields are calculated to prove equally striking. Owing to the great saving of time in grinding and polishing it will often be possible to reduce the cost of lenses and materials. The result of this will be that people will be able to afford optical instruments or photographic lenses which up till now have been completely beyond their means. Schools or research institutions which are not financially well provided for and which up to the present have been unable to maintain well-equipped laboratories will have the opportunity that they have wished for. Poorer people who have till now only been able to buy stock spectacles will be able to buy lenses to their particular prescriptions at reasonable prices. It may even be possible for hospitals to carry a large stock of lenses made to varying prescriptions which they may be able to dispense free-of-charge to the less fortunate patients.

Editor's note. Transparent molding resins of this character are made in this country by E. I. du Pont de Nemours, Co., Inc., and are sold under the trade name of Lucite.

VISUALIZING FOR CONSTRUCTION

(*Continued from page 33*) model. The telescope tube is roughly 60 ft. long, therefore, in the model it is a little under 2 ft. long. The diameter of the horseshoe at the north end of the telescope is 46 ft., therefore, its diameter in the model is somewhat under 1 1/2 feet. The foundation shown under the model does not represent an actual reproduction of the foundation which is being used. The foundation is made of structural steel and is not solid in appearance as it is shown in the model.

This model was not made merely to look at nor entirely to visualize the telescope as it will appear when completed. It was originally made for the purpose of carrying out angular deflection tests under load. These tests were carried out in a suitable mounting by attaching weights to various parts of the yoke and measuring the deflections which ensued. These measurements were made at every possible angle of the yoke.

The telescope is a structure built up by welding low carbon steel plates into hollow box structures. The distortions caused in pyroxylin by cementing sheets together with acetone are very similar in nature (although much exaggerated in degree) to the distortions which arise in steel structures when they are welded. For this reason, the making of the model gave many hints to the shop organization as to the types of problems which they might encounter in their welding. The model also indicated several desirable changes in design.

While the model was used for deflection tests it *was not* and *cannot* be used to measure stresses in the structure. No attempt was made to use polarized light in this model for stress indication. A three-dimensional model such as this is, with all sorts of initial strains in the material, is completely unsuitable for stress measurements. Stresses in the actual telescope are not large enough to present serious design problems.

This plastic model has been exhibited at various places such as the American Museum of Natural Science in New

Here's a Clever New Closure Plastic Molded by Consolidated

There's always something NEW from Consolidated's presses. This "tomato red" Arcolite cap for ketchup bottles provides a pouring spout with many advantages, characteristic of all Consolidated plastics. Glasslike surface assures smooth pouring, prevents clogging, is readily washable and practically unbreakable. "Catch up" with plastic molding progress by keeping an eye on Consolidated.

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An extra pale, superior lacquer alkyd increases gloss, durability and resistance to ultra violet rays.

Makalot A-402

A Superlative White Refrigerator alkyd, excellent gloss, compatible with pigments and free from yellowing.

Makalot A-409

For easy brushing mill white liquids in making mill white paints with excellent gloss. It's good for flat white liquid too.

Our technical service laboratory will quickly help you solve any of your paint, varnish or lacquer problems. We also have a wide line of Oil Solubles.

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Makalot 75-H

Hi Heat in black, brown, mottled and red, used in making approximately 60% of the heater and switch plugs produced by custom molders.

No. 1018 Black for quick curing, with beautiful glossy finish.

No. 1040 Low Loss for Radio—Aeroplane parts, etc.

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Dibutyl Phthalate
Diethyl Phtalate
Dimethyl Phthalate
Triacetin

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NEW YORK, N. Y.

York, and the Civic Auditorium in Atlantic City. It has also been used in many lectures given on the telescope both by members of the staff at the California Institute of Technology, where the instrument was designed, and by members of the staff of the Turbine Works of the Westinghouse Electric and Manufacturing Company where the structure is being built.

SYMPOSIUM ON ORGANIC PLASTICS

(*Continued from page 44*) "essence d'Orient" obtained from scales of fish, crystallized mercurous chloride, crystallized lead carbonate or finely powdered aluminum. To bring out the full lustrous sheen of these pigments, the particles must be oriented, which involves incorporation of the lustrous particles into the plastic while in a soft condition and extrusion through a flat orifice which draws out the crystals so that they lie in the same direction. Rods for use in the fountain pen industry can be made to exhibit the pearly sheen by producing small cubes of the oriented pearly plastic material and repressing them into a block from which rods are cut, these rods then being fabricated by the fountain pen manufacturer. Prussian Blue is an interesting pigment. It resists the heat of all the manufacturing operations and unprotected by glass will not fade in direct sunlight. Laminated between glass, cellulose nitrate plastic containing Prussian Blue will fade in sunlight, but if the glass is broken, the blue color will return. Prussian Blue is not at all permanent in cellulose acetate. Cellulose acetate is also unsuited for use with zinc oxide which is stable in pyroxylin.

INFRA-RED SPECTROSCOPY AND ORGANIC CHEMISTRY. III. GLYCERYL PHTHALATE by R. H. Kienle and R. Bowling Barnes. The glyceryl phthalate reaction employing specially purified raw materials was followed in an all glass apparatus operating under inert gas atmosphere at constant temperature. Samples of the resin at various stages in the progress of the resin formation were examined with an infra-red spectrometer, covering the range from 10,000 to 667 cm^{-1}, to determine variations of the intensities of the absorptions with the progress of the reaction. Practically no change in the carbonyl group absorption is observed, even upon passing into the gelled state. Uniform decreases in the intensity of the hydroxyl absorption, approximately proportional to the change in acid number, are noted. Definite decreases in the intensity of the absorption of the CH frequencies are also apparent. Upon gelation these absorptions increase in intensity. These infra-red measurements are in accord with the concept of intertwining of relatively small molecules as responsible for gelation rather than formation of very large molecular aggregates.

THE STRUCTURES AND THE PROPERTIES OF HEATED RESINOUS FILMS by H. L. Bender. A special bubble technique for preparing very thin films of resinous materials were described. These bubbles are readily kept

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- **VERSATILE**—this modern material, offered in sheet, rod and tube form, is assisting engineers to redesign for reduction in weight and size while improving appearance and service of products.
- **EASILY FABRICATED**—with regular shop equipment and personnel, it speeds production, keeps costs down. If yours is a representative production shop, there will be no need to set up new departments or to seek outside agencies for assistance in its use.
- **UNIFORM HIGH QUALITY**—Laboratory controlled in our plant (the most modern of its kind in the world). This material comes to you as a finished product, insuring less waste, no experimenting on your part in a manufacturing field foreign to your own. . . . Try Taylor Phenol Fibre. Tell us your requirements, we will submit samples.

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NORRISTOWN, PA.

WANTED:

The opportunity to lend our long experience and knowlege of the great possibilities of mouldings to manufacturers who want to improve their products at a saving.

Here X-rayed, is the solution of one difficult problem. In this housing for a Safety Fuse Changer, we had to combine strength, durability, and perfect insulation with practical design . . . . . and we did it with surprising economy and satisfaction to our customer.

There'll be no obligation to you in sending us your blueprints and specifications for estimate.

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when this ALNOR Portable PYROCON is on the job

Accurate Temperature control made easy by Inexpensive Portable Instrument . . . . . .

No matter what the material, the size of the molding, the number of cavities or the rate of the cycle . . . quality and speed can be improved if you guard your temperatures with an Alnor Portable Pyrocon. Rejects have often been cut ninety percent and more. Cycles are often speeded up far beyond former standards. Quality and finish immeasurably improved.

Yet, so low is the cost of the Alnor Portable, that many plants report it paid for out of savings in a few short months.

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428 N. La Salle St., Chicago, Illinois
"Alnor" Pyrometers are also made in permanently mounted styles for continuous readings.

intact if heat is applied while the bubble is being formed. Films prepared in this manner are found to be composed of an aligned assembly of macro-particles of visible size. Data as to the strength of these films with the particles arranged in various patterns was presented, and a theory was advanced to account for such particle formation. A revised interpretation of known data was given from the standpoint of this theory, namely, that resinous films are composed of an assembly of macro-particles of visible size but at random distribution.

U. S. PLASTICS PATENTS

(*Continued from page 48*) particles coated with liquid resin, compounded with solid resin, both resins potentially reactive.

THERMOPLASTIC. Henry Jenett (to Celanese Corp. of America). U. S. 2,076,781, April 13. Rubber and a solid cellulose derivative are ground together and dispersed in a liquid medium which is not a solvent for either component, to make a thermoplastic composition.

SOLUBLE RESIN. G. W. Seymour (to Celanese Corp. of America). U. S. 2,076,795, April 13. Making an acetone-soluble resin by acid polymerization of a sugar in aqueous solution.

SYNTHETIC RUBBER ARTICLES. Jas. E. Kirby (to E. I. du Pont de Nemours and Co.). U. S. 2,076,949, April 13. Making shaped articles from an aqueous dispersion containing over 55% of a chlorobutadiene polymer by dipping a mold into the dispersion, withdrawing the mold slowly and at uniform speed, and removing the dispersing agent from the coating which is thus deposited on the mold.

HYDROCARBON RESIN. Jos. Rivkin (to Neville Co.). U. S. 2,077,009, April 13. Making an alcohol-soluble resin from solvent naphtha by polymerizing the coumarone and indene in presence of a phenol which increases the solubility of the product in alcohol.

IMITATION LEATHER. H. G. Kittredge and A. J. Turner (to Kay and Ess Chemical Corp.). U. S. 2,077,112, April 13. A composition for making artificial leather on a paper base contains a rosin-modified phenol-formaldehyde resin and raw tung oil. The product is dried in such a way as to give a wrinkle finish to the artificial leather.

CAR OWNERS WILL LIKE THIS

(*Continued from page 38*) of flexible metal hose linings and it was a logical step to progress from improving the hose to the vital nozzle tube, upon which depends the efficiency or inefficiency of the entire unit. At first a soft, synthetic rubber tube was provided with a metal fitting on one end because it was thought that molded threads could not be made strong enough in the synthetic rubber alone. This proved troublesome, however, because the metal fitting leaked, then finally broke off.

After seeing a gear shift with fine threads molded of hard synthetic rubber, and making a few combination hard and soft Thiokol moldings for experiment, a plunger type mold with removable thread blocks was designed for the piece. This type of construction immediatly proved practical since the design incorporates the compression shoulder which takes the strain of flexing away from the threads, and the hard powder in the heavy section re-enforces the nozzle at exactly the right point. The soft part of the nozzle takes most of the flexing strain and the slight curvature given in a second operation in a hot aluminum mold provides the necessary angle to reach the many tanks to be filled. The molded

Precision Molding by WATERBURY PLASTICS

When you want precision molding at a saving specify Waterbury Plastics. The illustrated spool was molded in one piece instead of two halves thereby saving countless assembly dollars and being in one piece it's better. All dimensions are held to the closest tolerances possible. Only master molders—people with the finest of skilled craftsmen—can make precision molding at a saving possible. Therefore specify Waterbury Plastics and get the best.

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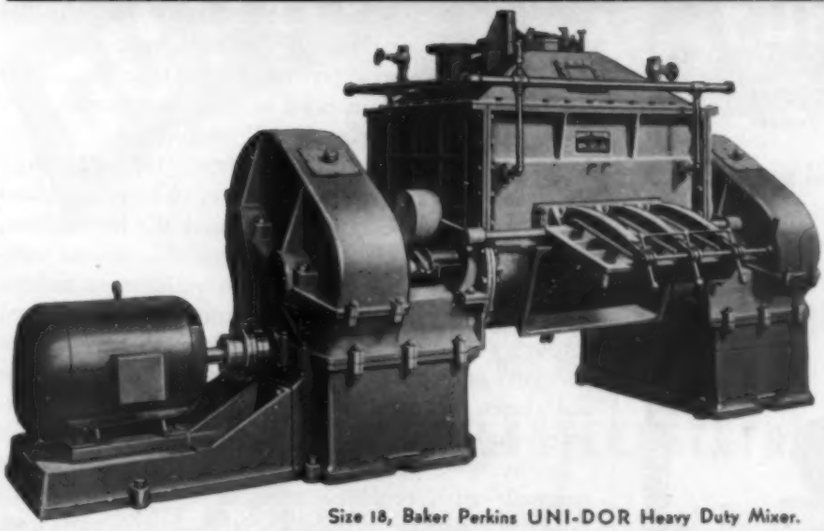
FOR HEAVY PLASTIC MASSES

THE B-P UNI-DOR MIXER



Size 18, Baker Perkins UNI-DOR Heavy Duty Mixer.

Very Rugged Construction

Gearing Totally Enclosed and running in oil.

Timken Bearings Throughout.

Step-Trough Design, with large quick-opening Discharge Door.

Optional Features: Cored Blades, Special Metal Construction, Jacketed Ends.

In all the years of W&P Universal Mixer development no single unit of equipment has won such instantaneous approval of chemical men as the new Baker Perkins UNI-DOR.

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for the best tumbling equipment, processes and service obtainable.

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The march is on toward "THE FINEST FINISH AT THE LOWEST COST."

Get in line with the rest of the progressive concerns. Write us now for complete details on how you can improve your product and cut down your cost of finishing plastics.

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Mfgrs. of LUPOMATIC slicing machines, jig saws, carving machines, carving tools, tumbling supplies, etc.

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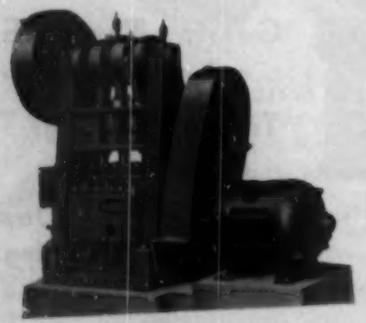
HYDRAULIC PUMPS

will meet the intermittent flow required by your Hydraulic Plastic Moulding Presses *without power loss.*

Our patented suction valve control gives 100 or 0 percent flow instantly.



Pump pictured above is fitted with double helical geering and silent chain drive to high speed motor but any other form of drive is available.

THE ALDRICH PUMP CO.—Allentown, Pa.

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threads also have the advantage of fitting any variation in the nozzle valve, giving a complete gasoline seal.

This tube is reported to give a longer life than any flexible metal tube in service. The highly polished bore provides a smooth passageway which enables the nozzle tube to put out a smooth and speedy flow. There is no dripping of gasoline after the nozzle is shut off or residue left in any metal spirals to drip on the fender of a new car. The ability of this nozzle to be turned in any direction with ease enables the operator to get into the new gasoline tanks and open the meter valve to the limit for quick tank fills. The former style had to be held at the mouth of the tank cap, and because of the uneven spiral and the outward flow of air by the nozzle tip, the pumps could only run at quarter or half-speed without gasoline being blown back.

The procedure for making the Gates nozzle follows in every detail the conventional method of producing a molded plastic part. The powder is weighed out in four portions; half of the hard and half of the soft are placed in the lower part of the mold, or in multiple cavities of multiple molds, and the core is placed and the other two halves of the powder leveled on top. The plunger is then closed and the finished article is pressed off the steel core. This operation requires only three minutes and compares favorably with the molding time of any piece of similar size when molded of phenolic or urea material.

INDUSTRIAL DESIGN AT PRATT INSTITUTE

(*Continued from page 29*) The problems given in the second year (the first year being devoted to a basic foundation course) are not problems in the ordinary school sense, but *definite design experiences*—experiences involving human needs, function, materials, tools, tool processes, costs and *aesthetics*. For example: during a school year the student will have the experience of designing a product to be spun in aluminum, one to be cast in brass or aluminum, another to be die-cast and later plated, still another involving the drawing of sheet steel or aluminum. He will design glassware to be blown, certain pieces to be pressed, and bottles capable of being made automatically by machine. He will continue with experiences in the various techniques of wood working, and with problems in molded plastics. He will design ceramic forms to be developed through every step of the process, and will have the opportunity of carrying out his own experiments with color and glazes. Certainly a unique range of design experiences—and all of them under the guidance of experts.

In the third year some of the same experiences are repeated—with problems more involved and complicated. In these are included the fabrication of parts from different materials and the assembly of designs which call for several or many parts. Lectures are given on production-methods, costs, market analysis and merchandising.

The typical procedure in carrying through the various industrial design experiences will be briefly described. Each problem passes through four to seven steps, depending on its nature and complexity.

If Your PLASTIC PROBLEMS Have You RUNNING AROUND IN CIRCLES

Try Stokes

If you must reduce the weight of a piece without sacrificing strength; want a piece to defy time and wear; give beauty to an "ugly duckling"—put your problems in the hands of Stokes designers. They don't look on your job as an outlet for their ingenuity but as a piece to be molded at the lowest possible cost and made in a practical way to facilitate its use and increase its salability. May we see your blueprints and specifications?

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Molders Since 1897
322 WEBSTER ST., TRENTON, N. J.
CANADIAN PLANT WELLAND, ONT.

A precison molding involving numerous planes and angles with metal inserts molded securely in place.

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U. S. P. Solution; Water White; Low in Acid; Low Metal Content

PARAFORMALDEHYDE

95% Minimum Strength

HEXAMETHYLENETETRAMINE

Products of Dependable Uniformity · Prompt Shipments in Modern Containers

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The R. & H. Chemicals Department
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The Clean Buffing Compound

LEAROK has no "free grease" in it. It is clean. It doesn't get into crevices and ornamentations. This, coupled with its excellent buffing properties, make it ideal for finishing plastics. LEAROK can be obtained tinted to match the color of the finished article.

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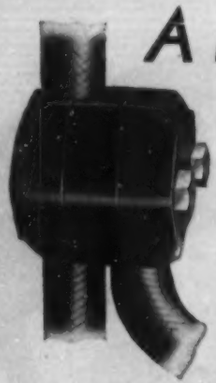
Another "ACCURATE" *molding!*



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● The Burndy Tapit, one of many hundreds of electrical connectors manufactured by Burndy Engineering Company, New York City, eliminates soldering and taping of electrical joints. Approved by Underwriters.

A canvas-Bakelite body, molded by "ACCURATE" around a copper block and steel plates, comprises this sturdy connector. The Burndy Tapit typifies real craftsmanship and quality in Bakelite molding. Whatever your problem in Bakelite or Urea Molding—*call on us!*

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MOLDING CORPORATION
120 NASSAU ST., BROOKLYN, N. Y.

1. Study of the problem
2. Expression of ideas in sketch form (two and three dimensional sketches)
3. Temporary descriptive drawings, made to scale
4. Three-dimensional design study (plastic or architectonic)
5. Duplicate plaster designs in plaster
6. Complete, fully dimensioned working drawings
7. Rendering or model

All problems start with a study rather than a drawing, for industrial design that fulfills all manufacturing requirements and wins mass acceptance (we are not concerned with esoteric design) is more than a drawing. It is a study, and it starts with the seeking of information—information concerning consumer needs and wants, broad style trends—and within the broad style trend, the few individual styles that are achieving mass acceptance. These styles become the fashion or vogue—the designer does not copy them. He seeks to understand the reasons underlying their popularity. The study continues with the engineering and the manufacturing problems, the materials to be used, the costs involved. Throughout this study, the manufacturing and commercial viewpoint is stressed. In other words, the designer must first know his problem in all its aspects.

Second year students are furnished with needed information, while third year students, for the most part, must do their own research to obtain sufficient data. This, in itself, is a unique experience and will teach the student to develop first-hand conclusions from evidence which he has collected himself. He will not proceed on second-handed conclusions passed on to him from the experience or knowledge of another person. It is important that the student be trained in initiative and judgment, as well as in skill of performance.

From the information made available, with all limitations known or foreseen, the student proceeds to carry out, to scale, the most promising sketch—by a plastic or architectonic method. If a wide variety of acceptable sketches are developed, two or more three-dimensional studies are made. Always a plastic or architectonic approach to design is used (unless a problem is very simple and easy to comprehend in two dimensions) because the products we design are three-dimensional. We use very little paper. We prefer rather, to use clay, plaster, wood, cast plastics, and sheet metal.

The plastic designs are duplicated in plaster, as many as three to five casts being made. Plaster is used in this phase of the design process because it is an excellent medium in which to study refinement of form and the play of light on a reflecting surface. Light and form are inseparable design factors, and herein lie the potentialities of not only beautiful and subtle variations, but also appeal. Here is the full development of the esthetic viewpoint as contrasted with the factory viewpoint expressed in a purely technical working drawing. Here is the final development of style. And by style we mean creative expression of distinction and character, all growing out of and all related to usage, ultimate materials and

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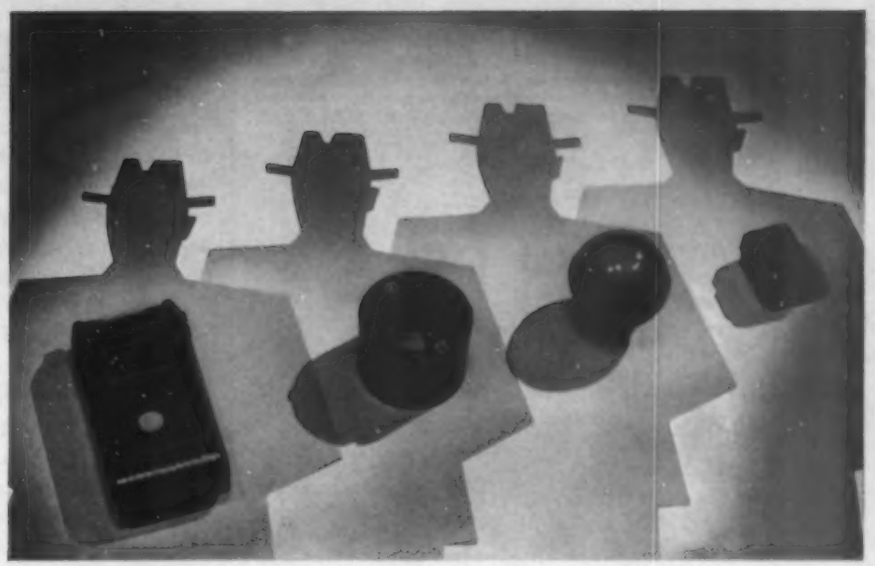

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If they don't, then get in touch with Auburn. Our years of experience in turning out parts so precise and so attractive that you point to them with pride is yours for the asking.

In plastic molding there is no substitute for experience and production facilities. Auburn excels in both—Let us help you.

MOLDED PLASTICS DIVISION OF

AUBURN BUTTON WORKS, Inc.

AUBURN, N. Y.

Now Available to Users of REX-WELD Flexible Metal Hose Connections

REX SELF-DRAIN SUPPORTS

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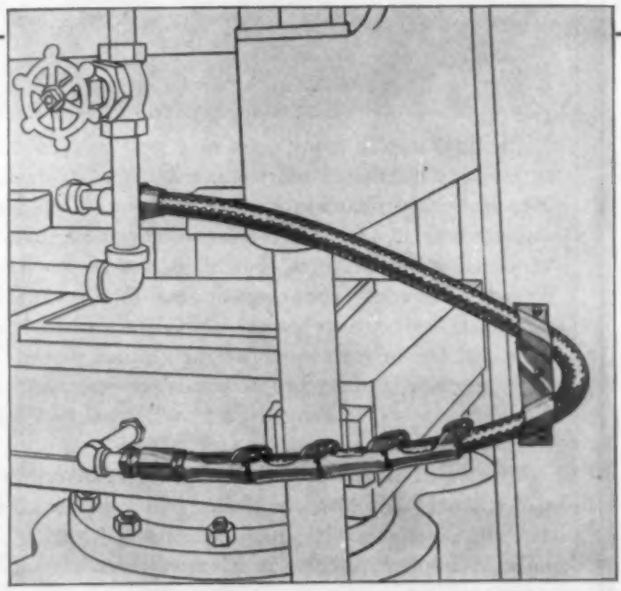

New Link Design—Most Practical Method of Supporting Long-Length Connections

Rex Self-Drain Supports—a Chicago Metal Hose Corporation engineering development—permits free movement of the unit at all times without allowing it to sag below the horizontal, and controls the flexing of the hose without unnecessary strain. Furnished as complete unit. Write today for new catalog illustrating and fully describing the many advantages of Rex Self-Drain Supports and Rex-Weld Flexible Metal Hose for platen press application.

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Now available for the first time, this new material—made and molded only by Standard Plastics Corporation—provides unusual beauty, color, durability and strength at a far lower cost than was usually experienced with previously available materials.

ALPHIDE moldings have high dielectric strength, are non-inflammable and available in an unlimited range of colors. Tool costs are far lower than for ordinary pressure or injection molding.

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tool processes. The style must spring from *within* the problem; it dare not be imposed from without as something extraneous. In this sense the old term "applied art" is dangerous in its suggestion of art added, *too late*, to something already made.

Several of the plaster casts permit variations, critical refinements of design—and between these we can make accurate and rational comparisons. Such comparisons can be made only between tangible and concrete three-dimensional forms: not as between drawings that only partially represent forms.

The problems lending themselves to the architectonic approach to three-dimensional design are also duplicated with slight change, by the use of many parts of varying shapes and proportions.

It is not the purpose of a thorough three-dimensional study to make a *model*. Models are made from fixed designs, from designs in their final form. Our purpose is to keep the design mobile and dynamic, never fixed or static, until it has been carried as far as possible.

The design has now come through various stages of development. It has been influenced and shaped by complex conditioning factors, some realistic and tangible, others subtle, intangible, psychological. Each group of factors is equally important. It is a short-sighted view of industrial design that imagines the intangibles (the really difficult part of the problem) to be of minor importance, when we know that for mass acceptance, the psychological factors may well be the ones that spell the difference between the commercial success or failure of a manufactured product.

The design is now ready to be crystallized in a set of drawings that most artists cannot even read—working drawings, which go to the factory as blue-prints, accurate, definite to every smallest detail. Full information and description on paper—blue-prints, the most effective and economical method yet devised by man for conveying a *fixed* idea in graphic form. By contrast, it is in this form that most factory-minded designs begin—and end.

The final step in many cases may well be a rendering or *picture* of the design in its finished form. The rendering, while legitimate in that it permits color, details and accessories, and suggests or interprets finishes, has very definite limitations, where industrial art is concerned. To carry the three-dimensional essential in industrial design to its logical conclusion, is to fabricate an actual size or scale model of the finished design, true in form, color, and texture, to the as yet un-made manufactured product. Thus the cycle of design procedure is completed.

This article covers the broad objectives, as well as the major procedure phases of training in industrial design at Pratt Institute. The more specific and intricate details are implicit in this statement of the nature and sequence of experiences.

The student has made a vital discovery. He has found that design is not an activity based solely on inspiration, but one of reason as well. This simple fact will take a permanently motivating place in his mind so

long as he lives. It will bring him face to face with the realization that the factors involved, previously thought of as limiting and compromising, offer a direct challenge to his creative ability. He will be happy in his realization of growth, and the thought that, unlike many artists, he is not continuing to produce a certain vicarious beauty unrelated to life; but quite the contrary, creating an art that is vital, because it grows out of, and is related to the needs, materials, and tools of his—the industrial age.

SELECTING SPECIAL PHENOLIC MATERIALS

Mechanical problems

Some time ago synthetic yarn manufacturers sent out a call for a material which could be molded into intricate shapes and which would resist the chemicals used in synthetic yarn manufacture. Also, the material must not expose filler spots or the slightest roughness after frictional wear had removed the original film of resin from the surface of the moldings, as this would damage the delicate fibres. Water absorption must be extremely low, because dimensional changes would render the parts useless, and none of the above properties must be impaired by sanding or machining operations required by

the intricacy of the parts. Such a material was developed and has been giving excellent service in the fast-growing synthetic yarn industry, replacing parts made of metal and wood which had definite disadvantages.

Higher impact strength

Impact strength is another property about which too much cannot be learned, since many of the newer uses for plastics demand greater impact strength with the same smoothness and luster always associated with phenolic moldings. Such parts as toaster bases must be extra strong to withstand dropping. Certain telephone parts must also have extra strength, but must match in color and texture with regular moldings. Housings for valves, small mechanical devices, etc., which are often removed and almost as often dropped, require extra shock-resistance. Your dictating machine mouthpiece must resist many impacts. Bumper shoes in car doors

Whatever your device . . .
A DIEMOLDING housing will make it more practicable, more beautiful, more lasting . . . and probably LESS Expensive!

Witness the Gates-Mills "Glove-Fit" machine . . . a device used in countless stores to quickly and accurately measure the hand for fitting gloves. In its Diemolded housing, this machine is inexpensive, beautiful enough for the finest store and sturdy as can be.

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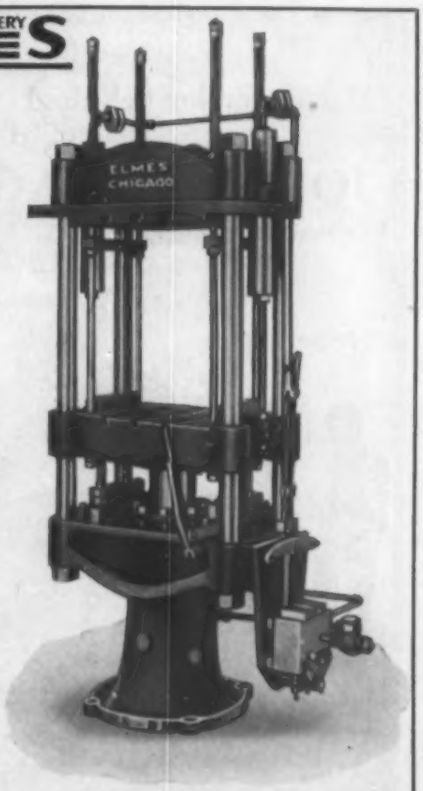
SINGLE LEVER CONTROL

We offer a Complete line to operate from Accumulator System or Independent Pumping Unit



Model 4634
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and anti-rattle devices in motor car bodies must take terrific impacts without chipping or cracking. More materials have been developed to resist impact than to meet any other requirement which plastics have had to endure, and today, moldings can be made at slight extra cost which have two and three times the impact resistance of standard compounds, yet have the same luster, smoothness and intensity of color. Even newer materials are available with five times the impact strength of ordinary phenolic compounds, with a slight waviness of the surface detectable only to a practiced eye.

High compression in the new motor cars has brought fresh problems to the plastics industry. Higher compression ratios require higher ignition voltages, and while increasing ignition voltages was relatively easy, the dielectric strength of the phenolic plastics used in ignition parts was at first not equal to the demands. Dielectric breakdown, carbon tracking and dielectric fatigue occurred. How well phenolic materials have succeeded in attaining higher dielectric strength and arc-resistance is shown in the excellent performance of the modern ignition systems, although the problem is still a subject of constant research.

Purchasers of molded parts should not interpret this as a complete listing of the special phenolics available, nor should they forget that special compounds are constantly being developed. Combinations of qualities found in two or three special materials are often made, and requests for new properties are frequently encountered. The word "Impossible" is seldom heard in material manufacturers' plants.

WHERE BEAUTY BEGINS

(*Continued from page 21*) impervious to live steam is essential to avoid rust forming within the tubes because rust would discolor the hair during the waving operation.

At the end of each tube where it fastens to the clip (Fig. 1) there is a steam trap of molded phenolic material (Fig. 2) made in two parts threaded together. This trap collects all condensation which drains back to the boiler when the wave is completed. The hose attachment (Fig. 3) which connects with the ring is also of molded plastic as well as the handle of the clip, which is safe and comfortable to use.

Another utensil important to the beauty salon is the artificial dryer for hair. These until recently were made of metal sometimes fitted with a plastic collar (Fig. 8) to avoid the sensation of burning should neck or shoulders come in direct contact with it. The introduction of molded hoods is a more recent and desirable development because the plastic used this way transmits none of the heat but rather concentrates this heat upon the hair with increased efficiency and economy of operation. The air used for hairdrying is usually heated electrically and any economy which prevents wasting this heat reflects naturally in the operating expense. It also minimizes the periods of time required for this rather tedious necessity.

Scalp treatment is another thing in which science has improved outmoded technique. It is considered that the

12. Molded shampoo tray made for the Art Chrome Company

controlled flow of fresh steam is better to cleanse and refresh the scalp than the old-fashioned use of hot towels. For this purpose a different type of molded hood was recently introduced in which an opening on either side permits a masseuse to work on the scalp in the presence of steam. Since molded phenolics are unaffected by this constant contact with steam and since there is no possibility of their becoming corroded in use it is natural that manufacturers of this steamer equipment chose this material for its hood.

Modern shampoo methods no longer require the contortions of bending over a basin with a towel to keep the soap from the eyes. Instead a molded plastic tray with a high splashproof wall is attached to the back of a chair which is tilted at the proper angle to allow the soap and water to drain back into the basin. Steam, soap and so

13. A steam tray molded by Auburn Button Wks. Inc. for J. P. Fisher, Inc.

CUSTOMERS MIGRATE

. . .like Ducks

They seldom come back, once they're dissatisfied. Maintenance of color, form and texture of a plastic product is only good business. It holds your customers. Maintaining proper mold temperatures is an all important factor. A Cambridge Mold Pyrometer is the instrument that powder manufacturers use in their laboratories and recommend that you use in molding plastics from their powder.

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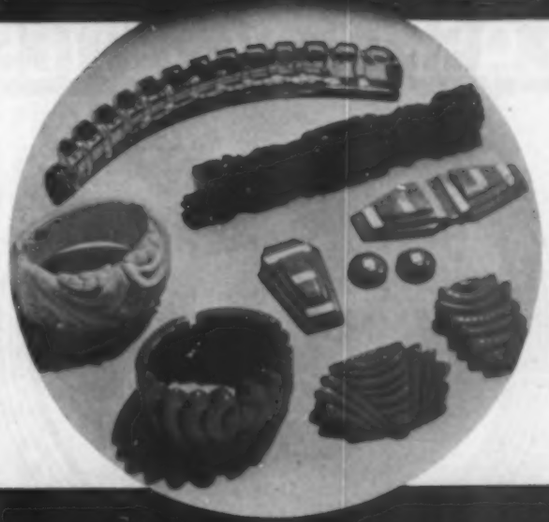
Send for details of these instruments. They will help save money and make better plastics.

Master fabricators of CAST RESINS



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For the Jobbing Trades Exclusively

SPEAKING OF FINISH...

The larger the piece, the harder it is to control finish and achieve perfection throughout.

Yet, Attleboro makes most of the largest housings... particularly for such high finish articles as radio cabinets.

Hence, Attleboro has learned all the tricks ... knows how to give your product that perfection of finish you and your public seek in a quality molded article.

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CASEIN PLASTICS

SHEETS and RODS
• Non-inflammable
• Made in beautifully mottled and plain colors

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forth can't dull its luster and the incidental shocks that it gets in service do it no harm because it cannot chip.

The handle of the electric clipper illustrated on page 19 indicates another practical application of plastic materials on electrical equipment.

In all these plastic applications there is the advantage of lasting color which may be chosen to match or to contrast pleasantly with the color scheme of the shop. This efficient scientific equipment is at its best in a modern setting. Architects responsible for the decoration of beauty shops can employ no better material for the eventual economy, durability and sanitary qualities than laminated plastics. Many shops employ these materials as wall paneling, wainscoting, mop rails, kick plates, doors and it has become standard practice to make manicure tables, arm rests, and other exposed surfaces of plastics because of their chemical inertness. They are impervious to dyes, alkalies, and cleaning agents, resistant to cigaret burns, scratching and marring and their satin finish is permanently sustained by occasional cleaning with water. No reconditioning of walls is required. Therefore the continual operation of the booths is not disturbed frequently by repainting. And laminated materials are available in a sufficient range of colors to meet the most exacting demands of design.

FROM HOURS TO MINUTES

(*Continued from page 30*) supplement older substances.

Cast resins, one of the newer man-made materials which appeared less than ten years ago, have speedily become indispensable for the fabrication of all types and kinds of sports and costume jewelry. Through their use, much of the ancient craftsman's feeling and spirit is maintained although work previously done by hand is now accomplished with the aid of ingenious machines developed especially for carving and fabricating these plastic materials. Actually, it is a species of hand work facilitated by means of rapidly revolving grinding wheels. However, the principles involved are different. For example, the cameo was originally wrought at great expense of time and labor by the craftsman who held the stone firmly in one hand or in a vise, and with the other hand moved his cutting tool over the surface to carve it. Today's machinery for fabricating cast resins works directly opposite. A stationary grinding wheel moves at a fast rate of speed while the operator holds the piece to be carved in both hands and guides it against the wheel, cleverly working out intricate patterns. Then, with a minimum of polishing, the piece is ready for findings which are attached by a foot treadle operated machine.

Examples of cast resin fabrication illustrated are the products of Ace Plastic Novelty Corp. and were cut from Marblette. The production of this particular shop is marketed solely through manufacturing jewelers who assemble and distribute the plastic parts. The candid camera shots taken in the plant indicate the extent and refinement of the operations. At the time this company was organized, some five years ago, cast resin

fabricating equipment was in its infancy, and like craftsman of old, it was necessary to experiment with the material to learn how best to adapt it to modern use. There were no precedents to follow on this particular type of jewelry and designs had to be built to coincide with contemporary style trends.

"We first had to figure it out for ourselves," says A. D. Seidman, president of the company, "and then we had to train men to do the work, for there were none who were familiar with this material. We had little trouble in getting women to appreciate the beauty and desirability of cast resin jewelry once we were able to produce it, but we were often stymied in our efforts to create the designs and get the effects we wanted to bring out."

That this company has progressed along the right track may be gauged by the fact that it started with a floor space of 2400 square feet which has long since grown to 20,000 square feet, and its original staff of two or three workers has increased to 135 or 150. Its design department regularly employs two or three artists constantly at work developing new designs. Often these designers cooperate with the trade in making special patterns which are usually confined exclusively to one wholesaler.

Timeliness is of the utmost importance in producing costume jewelry, for fashions have an inclination to change frequently and accessories must keep step with them. One of the many advantages of such jewelry fabricated from plastics is that a manufacturer can get an item through quickly and can stop it just as promptly when demand dwindles, with little or no loss of material other than the few pieces he may have prepared ahead and as a general rule, only small quantities of completed merchandise are carried in stock.

Women's clothing today places particular emphasis on color, and accessories to be acceptable must follow the same vogue. Color has always had great attraction for men and women in all ages and the rich, deep, lustrous tones of cast resins make them fit perfectly into the ever-changing tempo of modern living. Low material and low fabrication costs make it possible for women to enjoy the possession of several sets or pieces to harmonize with costumes for daytime or evening.

Plastic jewelry is not in any sense a substitute for pieces made from other materials. It has created a comfortable niche all its own because of its adaptability, its decorative value and its brilliance. It is equally effective used alone or to complement other materials; in fact, plastics combine harmoniously with metal or wood and are even seen in combination with leather, lending a touch of color and charm to more conventional materials. The development and expansion of cast resin jewelry has stimulated the sale of all other types since it has been largely responsible for making women jewelry-conscious and appreciative of the glamour it attaches to the simplest frocks.

According to Mr. Seidman, strings of graduated beads, highly polished, are particularly popular for the coming spring and summer. Though a bit bulky in appearance,

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when in need of PLASTIC MOULDINGS
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MOST UNIVERSAL EQUIPMENT—TIME HONORED SERVICE
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IF YOU STILL THINK
YOU MUST USE METAL
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All too many manufacturers think of moldings as merely decora-
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It may have been so once. For at the American Insulator Corp. we know how to mold parts
for high impact strength . . . parts that stand up under shocks far
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These parts get punishment . . . and take it in their stride. So, if
you still think you must use other materials . . . we say, "Investigate
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A completely modern injection molding plant . . . with over *fifty years* of successful service to its record.

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they are really feather-weight and will be seen worn with light dresses, prints, etc., for beach and town activities. Beads in myriads of color—white, red, royal blue, turquoise, coral, pink, maize, French violet, lilac and green—are being turned out in this factory at the rate of two thousand gross a day. Deeply carved bracelets, clips, earrings, pins and rings continue to find favor for all occasions and handpainting in bright colors on the under side of transparent cast resin bids fair to becoming a favorite pattern.

Although cast resins do not hold the field of jewelry fabrication to the exclusion of other plastics, they possess the ability to resist heat which dictates their use whenever this factor is an advantage. Cellulose plastics, which may be fabricated in much the same manner, have contributed their share to the popular approval of plastic jewelry and thin sheets of this material have been widely employed in the manufacture of decorative artificial flowers for personal wear. Cellulose plastics may be molded as well as fabricated and it is being whispered that within a short time cast resins will be developed which can be handled in the same way.

INJECTION MOLDING, HERE AND ABROAD

(*Continued from page 26*) uting their share toward the development of injection molding but it is the writer's opinion that their line of work is widely diversified and that short runs may constitute a handicap. This shouldn't be so, however, because one of the advantages of injection molding is lowered cost through the use of molds with fewer cavities than are required by compression molding to obtain comparable production.

We must not leave the impression, however, that Europe does not apply the injection molding method to industrial parts because many electrical and radio parts are injection molded. But the preponderance of work, from the writer's observation, shows that the analysis for possible applications there varies from our own.

We believe this difference is highly in our favor, because when manufacturing problems are considered in America, the item is viewed from the angle of its utility in the general scheme of American life. The choice of materials and methods of production progress in a natural manner. With better understanding and appreciation of the tremendous possibilities ahead in the packaging field, American molders are equipping their plants to handle their share of this profitable business. The beauty and selling appeal inherent in thermoplastics through their brilliant colors and their adaptability for injection molding will change this balance. Only when a comparison is made between the volume of molded articles here and abroad will it be found that a preponderance of industrial, rather than artistic, applications exist in our market as compared with Europe.

During the past ten years the writer has made periodic trips to Europe to keep informed of the progress made on the other side of the Atlantic and to draw comparisons to determine so far as possible the potential field for high grade injection molding equipment in our country. Dur-

ing these years of investigation it was extremely interesting to note the change in trend toward the use of high-production equipment abroad. High-production equipment and America have always been synonymous, but in recent years conditions in Europe have shown a rapidly progressing change in this direction. The labor factor is gradually assuming the same ratio toward the finished product in Europe as in the United States. Standards of living abroad are changing, which automatically indicates that the labor factor in the finished article assumes greater proportions with a consequently greater demand for automatic high-production equipment. As a result of this condition foreign ingenuity is meeting the situation by the development of equipment of the highest type to meet these new requirements.

Even in Czechoslovakia, where it has been the habit to include a tremendous amount of hand labor in articles for export, the situation has changed. Automatic equipment to reduce labor costs and speed up production is being discussed in much more favorable terms.

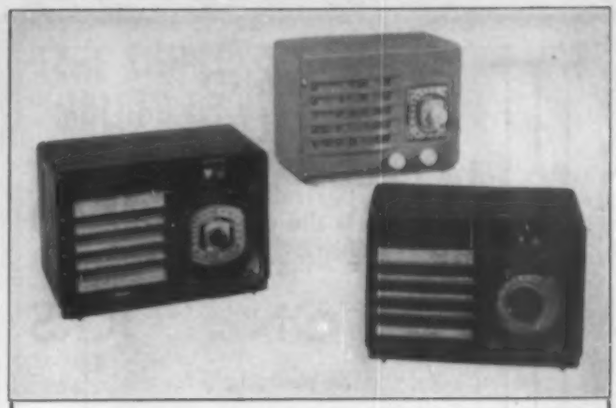
Automatic injection molding had its inception abroad, I believe, and the development of equipment suitable to this method of manufacture has a background of many years. This is clearly reflected in the examples of European manufacture with which this article is illustrated. Keen in design, intricate in construction, they exemplify the trend toward injection molding and indicate some of its tremendous possibilities.

It is indeed gratifying to note the enthusiasm with which the subject is being discussed in the United States and to observe the inclination of all those interested to keep the industry on a high plane where it deserves to be. The art of molding and the selection of proper applications for each method of manufacture is one that justifies the highest respect and consideration of all industry. It is also gratifying to me that molders are striving in every way to extend the utility of the art into channels which have not felt its benefits before. This is sure to result in increased benefits to branches of industry most in need of economies in production, and in increased business and profits to those molders whose plants are equipped with injection presses.

The field ahead is broad and long. The application of injection molding as a modern and rapid method of practical manufacture is limited only by the imagination of the designing engineer and the molder with whom he chooses to work.

GLYCEROL IN PLASTICS

(*Continued from page 45*) calcium sulphates. By refluxing the glycerol for 14 hours in the presence of approximately 4 percent of the catalyzer, there is obtained about 60 to 88 percent yield of the synthetic resin which is dark brown, viscous and soluble in water, alcohol, acetone and in mixtures of alcohol and benzene. On heating it loses 10–15 percent of water, becomes infusible and can form elastic films. On solution of the primary resin in water and steam distilling, there remains 31–50 percent of a dark brown secondary resin, insoluble in



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water. This corresponds to the formula $(C_5H_7O_2)_n$, apparently containing two OH groups. This product is suitable as an adjuvant to the bakelite type of resins, particularly for the production of acid resisting coatings.

Glycerol also enters into the manufacture of plastic materials in which its usefulness depends more upon physical properties than upon chemical characteristics. Glue compositions employ glycerol extensively as a softening agent as in a patented composition of glue, water, paper pulp, talc, tripoli, glycerine and methanol.[13] In other instances glycerol is used in the finishing of certain types of plastic materials, giving them gloss, smoothness and making them less brittle.

Not only in the solution of old problems, but also in the creation of new products, the importance of glycerol may be expected to increase as an essential basic raw material of the plastic industry, as the use of molded plastics is extended by research and practical application.

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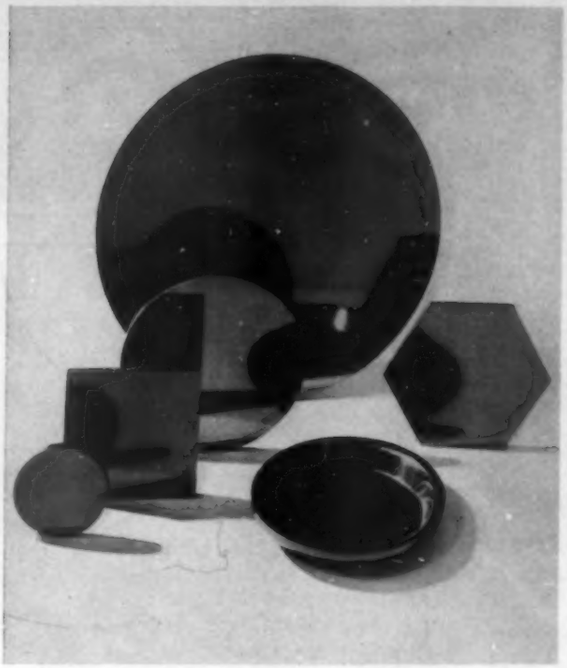
LIGNIN AND LIGNIN PLASTICS

(*Continued from page 47*) clave for 8 hours under 25 pounds pressure. The alkaline liquors were then drained off, the cobs were washed with a stream of water and the wash water was added to the alkaline liquor. This liquor was filtered and then made acid with an excess of either 50-percent sulphuric acid or with concentrated hydrochloric acid. The liquor was boiled for half an hour and allowed to cool to room temperature. The precipitate was separated in a basket centrifuge and dried at 100° C. The optimum conditions of (a) ratio of lignin to amine, (b) temperature, and (c) time of heating were determined for each aromatic amine studied. The optimum time of heating was found to be 1 hour in each case. The other experimental conditions are shown in table 5. The resins thus prepared were brown to black in color and variable in toughness, many being quite brittle. All of them were fusible and readily soluble in mixtures of organic solvents, such as furfural, benzene and 95 percent ethyl alcohol (1:1:1: by volume), benzene and ethyl alcohol (1:1 by volume), and benzene and acetone (1:1 by volume).

Reaction of lignin with furfural

Lignin will also condense with furfural to yield hard, black resins. Phillips and Weihe (22) reported a number of experiments on the use of various catalysts for accelerating this reaction. The conditions which they found to be most favorable are shown in table 6. The resinous product obtained with pyridine did not



Samples of the Forest Products Laboratory's lignin plastic

become hard. The basic catalysts yielded resins which were fusible and soluble in a mixture of equal parts by volume of ethyl alcohol and benzene or of acetone and benzene. On the other hand, the furfural-lignin resin which was prepared by using the hydrochloric acid catalyst was of the insoluble and infusible type.

The preceding examples of methods of producing molding materials from sawdust, lignite, corncobs, and oathulls serve to indicate possible means of utilizing these and other waste products. The low cost of these plastic compositions estimated by various authorities as from one-fourth to one-tenth that of the usual phenolic molding materials, is offset to some extent by the longer molding cycle required. Their lack of resistance to moisture, tendency to swell and warp, and generally permanent fusibility are properties which for many purposes have made them inferior to the well-established phenol-formaldehyde resins. However, it is known that considerable experimental work has been carried on in industrial and government laboratories on the production of molding compounds from lignin during the past few years, and many of these difficulties have been overcome or mitigated. It is expected that a commercial lignin-resin molding compound will become a reality during 1937. It is hoped that concurrently much information on the reaction of lignin with various chemicals will become available in published form.

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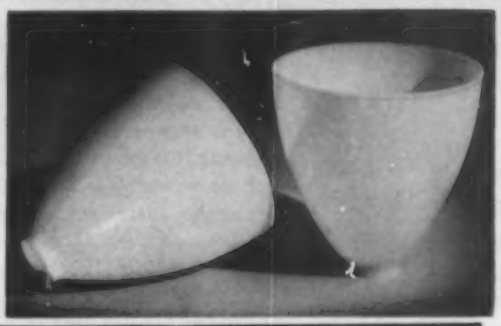

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